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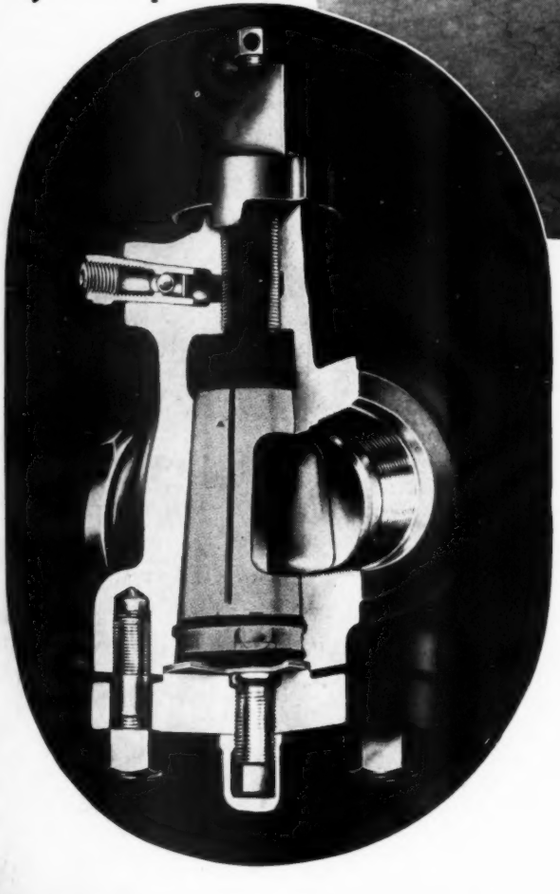

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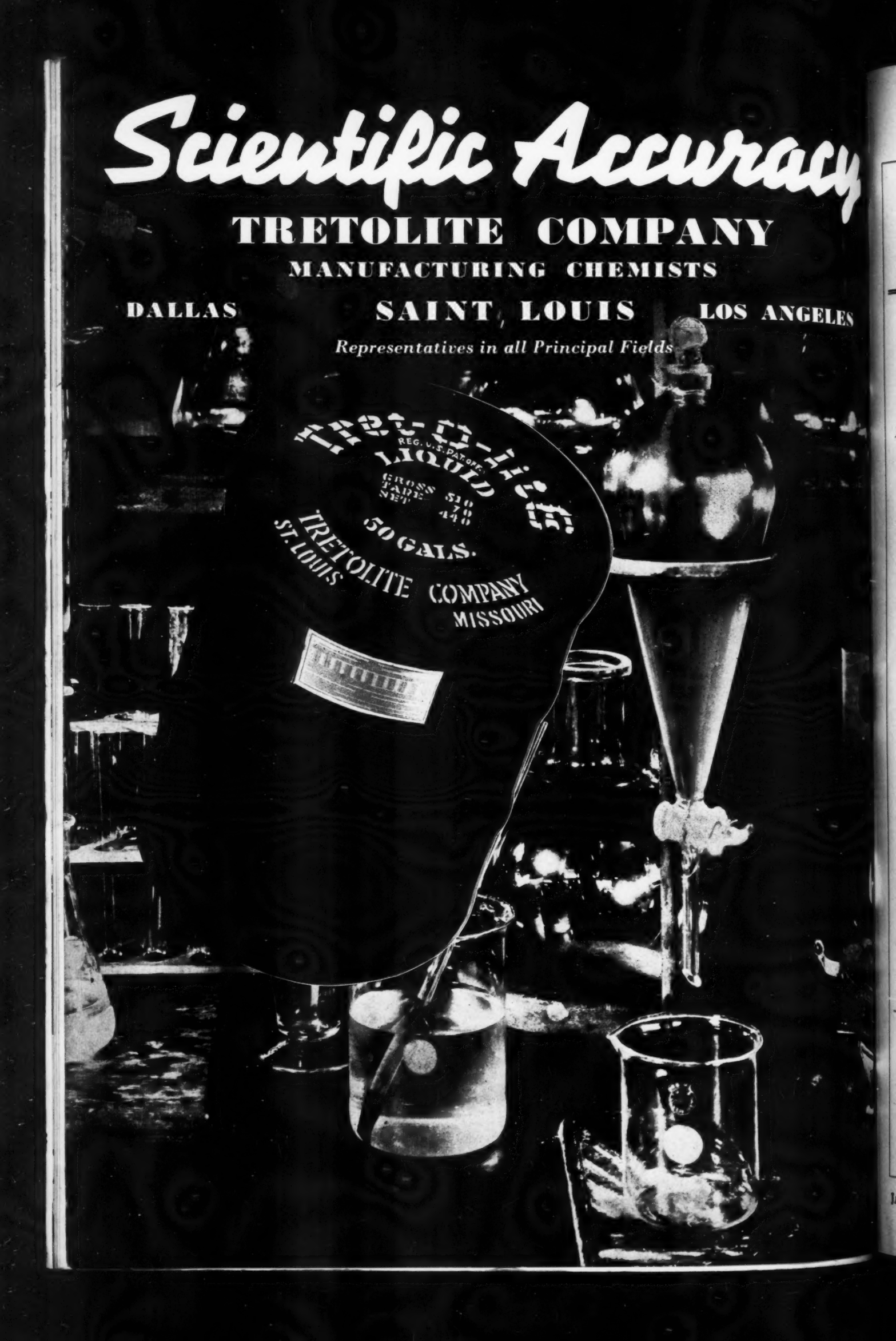

THE Petroleum Engineer

JANUARY 1937

VOLUME VIII NUMBER 4

A MAGAZINE OF METHODS FOR OPERATING MEN

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Meetings

- California Natural Gasoline Association—February 4, Richfield Building, Los Angeles, California.
- American Institute of Mining and Metallurgical Engineers—February 15, 16, 17, 18, and 19, New York City.
- American Society for Testing Materials, 1937 Regional Meeting and Committee Week—March 1, 2, 3, 4 and 5, Palmer House, Chicago, Illinois.
- American Association of Petroleum Geologists, 22nd. Annual Convention—March 17, 18 and 19, Biltmore Hotel, Los Angeles.
- Petroleum Industry Electrical Association—April 8, 9 and 10, Shreveport, Louisiana.
- Western Petroleum Refiners Association, 25th Annual Meeting—April 26, 27, and 28, Arlington Hotel, Hot Springs, Arkansas.
- Natural Gasoline Association of America, Annual Convention—April 28, 29, and 30, Hotel Tulsa, Tulsa, Oklahoma.
- American Gas Association, Natural Gas Department—Week of May 10th, Kansas City, Missouri.
- American Petroleum Institute, Mid-Year Meeting—June 1, 2 and 3, Broadmoor Hotel, Colorado Springs, Colorado.
- Oil-World Exposition, Inc.—October 11, 12, 13, 14, 15 and 16, 1937, Houston, Texas.
- International Petroleum Exposition—May 14, 15, 16, 17, 18, 19, 20 and 21, 1938, Tulsa, Oklahoma.

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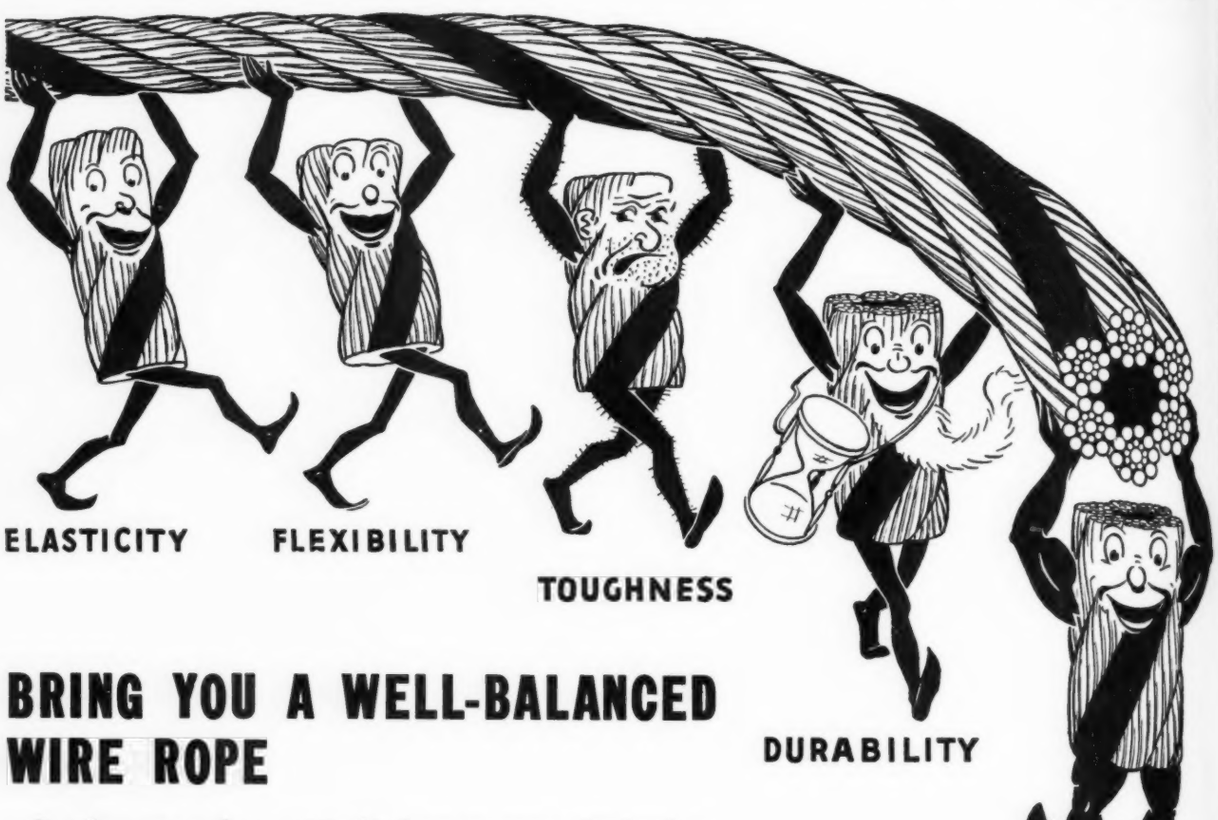

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The Course of Oil

By K. C. SCLATER

Drilling Activity In 1937

Year-end statements of executives in the industry are, on the whole, optimistic in tone. In 1936 the total domestic crude production was, for the first time, greater than one billion barrels, or ten percent greater than in 1935. An increase in gasoline demand of ten percent in 1936 over that of 1935 was a pleasant surprise, together with an almost similar gain in demand for gas oil, distillate fuels, and residual fuel oils.

Conditions in the industry throughout 1936 were remarkably stable. Production was held within reasonable bounds of demand. The Interstate Compact Commission made great progress toward aiding the maintenance of equitable production among the various oil-producing states. Proration is on a sounder footing than at any time in the history of the industry, despite the disposition on the part of Texas to disregard the Bureau of Mines recommendation and the retaliatory course taken by Oklahoma and Kansas last month.

Drilling during 1937 promises to be particularly active, perhaps more active in certain areas than ever in history, judging from present activity.

C. D. Lockwood of Houston estimates that in Texas alone the oil industry's drilling program costs $1,000,000 daily. This estimate is based on an average drilling well cost of $1000 a day, and 1,049 wells actually in the process of being drilled at the beginning of 1937. It is to be noted that this does not include 275 locations, 24 derricks, and 110 wells that were partly or completely rigged up preparatory to spudding in; nor does it include 245 wells that were shut down, either temporarily or indefinitely. The complete list of operations in Texas at the beginning of 1937 shows 1703 wells, a gain of 20 percent over that of a year ago.

Other estimates by Lockwood show that Coastal Louisiana's drilling program is about 35 percent higher than it was a year ago. At the beginning of 1936 Coastal Louisiana had 56 drilling wells; it now has 74.

Southeastern New Mexico's drilling program in January, 1936, was 62 drilling wells; early in January, 1937, there were 90 drilling wells, a gain of 50 percent.

Drilling activity in these districts is typical of the increase in drilling operations in many other active areas. Intensive wildcat drilling campaigns in the search for new fields is expected to feature field operations during 1937. Every effort will be put forth to uncover new reserves to replace the depletion of those now being drawn on to supply current needs.

Expenditures for Research

At a meeting of petroleum technologists held recently in London, England, one of the speakers, in commenting on petroleum research, said in effect that great oil companies had a strong duty to posterity. Being trustees for the time being of the world's petroleum resources, they had no right to waste these resources in any way whatever. By carrying on research oil companies ought to put back at least one-tenth of their income toward what is, to all intents and purposes, putting back in the form of knowledge what they take out of the earth in the form of oil.

This suggestion is no idle overestimate of the importance and value of research, as many leaders interested in the industry's welfare well know.

Appropriations for well-organized research is a prudent investment the returns from which, though they may be intangible or indefinite of appraisal by ordinary yardsticks of measurement, have a commercial value that exceeds many fold that of the original cost of research. Commenting on research in his year-end statement, Axtell J. Byles, President of the American Petroleum Institue, observes: "There is no longer any doubt that the industry's investment of more than $10,000,000 annually in research is paying substantial dividends in conservation, improved products, and reasonable prices. The technologists have demonstrated their ability to expand reserves by improving the efficiency of producing and refining operations and to provide economical substitutes should it ever become necessary to supplement the natural supply."

Fundamental research is as vital to the progress and well-being of industry as food is to the sustenance of life. This applies with peculiar emphasis to petroleum. Research has pointed the way to the wise production and utilization of this great natural resource the many products of which, developed all within a short span of seventy-five years, have contributed so much to the common good.

Cooperation In Rodessa Field

Louisiana Conservation officials are making a commendable effort in Rodessa (Louisiana) field to enforce proration regulations that in their judgment will conserve gas and gas energy and be to the best interests of all operators in the entire Rodessa field. Evidence of this is seen in the recent order issued whereby allowables will be based fifty percent on acreage and fifty percent on bottom-hole pressure and gas-oil ratios limited to a maximum of two thousand cubic feet of gas per barrel of oil. The laudable course pursued by the Texas Railroad Commisison in issuing for the Texas side of the field proration orders that conform in the main with those of the Louisiana Conservation Commission—namely, the determination of allowable from acreage and bottom-hole pressure — was an encouraging example of cooperation for which members of the Texas Railroad Commission, together with members of the Louisiana Conservation Commission, merit the full support of operators in the Rodessa field.

« « HIGHLIGHTS IN OILDOM » »

New Proration Orders for Rodessa Field

Louisiana and Texas governing bodies have issued new proration orders for the Rodessa field, which became effective January 1st. The order of the Louisiana Conservation Commission was first to be announced and in it are contained rather drastic regulations aimed to curb the waste of natural gas in the field.

Under the order total production of approximately 60,000 bbl. daily for the field was left unchanged, but allocations to many of the individual wells have been altered. Some have a sharply reduced output under the new regulations due to the fact that distillate wells are classified as gas wells and subjected to the same rules that govern gas wells. This may result in some of the distillate wells being shut in.

The new order fixed the gas-oil ratio at 2000 cu. ft. of gas per bbl. of oil. A new proration basis also has been established for the field, allowables being based 50 percent on acreage and 50 percent on bottom-hole pressure.

Following the lead of the Louisiana Conservation Commission, the Texas Railroad Commission prescribed proration regulations for the Texas side of the Rodessa field; they also became effective January 1st. The regulations harmonize with those put into effect by the Louisiana commission.

The order by the Texas commission also allocates allowable 50 percent on acreage and 50 percent on bottom-hole pressure, replacing the system of allowing each well a specified production, at the time 225 bbl. daily. A factor of adjustment for wells with unusually high gas pressures is included in the new orders.

The order establishes a maximum of 20 acres and a minimum of five acres for computing lease allowables. The allowable of a well on less than five acres will be figured on a basis of five acres, and if on more than 20 acres will be computed on a basis of 20 acres.

•

Amelia Well-Spacing Regulations

The Texas Railroad Commission, in a recent order, has provided five-acre spacing for wells in the Amelia field of Jefferson County, Texas. They may be drilled 233 ft. from lease lines, and 466 ft. apart, the order states, also providing for a 200-ft. string of conductor pipe, and 1450 ft. of surface casing. A maximum gas-oil ratio of 2000 cu. ft. per bbl. oil also is established.

•

Louisiana Coast Area Has Record Well

When The Texas Company successfully completed its No. 5 Rigolets in the Lafitte field, Jefferson Parish, Louisiana, a record was established in that it is the world's deepest commercial well producing by natural flow. It was completed at a total depth of 10,224 ft., producing initially 1636 bbl. a day through 3/8-in. choke, the oil being of 34.6 gravity. Back pressure was 1500 pounds.

A string of 7 5/8-in. casing was cemented on bottom, which was perforated for the production test; 2 1/2-in. tubing was run to below 10,000 feet.

No. 5 Rigolets is the tenth producer for the Lafitte field, situated 30 miles south of New Orleans. The field is owned entirely by The Texas Company.

Majors Fail to Follow Price Advance

The 17-cents per bbl. price advance on crude oil announced by the Continental Oil Company, effective January 4th, and followed by the Barnsdall Oil Corporation, to date has failed to gain the support of other major companies. In some areas, however, such as North Texas for example, certain buyers have been forced to come within a few cents of the Continental's postings upon threat by the producers to turn their connections over to the Continental.

•

Pennsylvania Crude Oil Price Advances

On December 28th an advance of 12 cents a bbl. was announced on Pennsylvania crude oil. Under the newly-established prices the quotation for Bradford oil is $2.57 a bbl.; Southwest, $2.32; Eureka, $2.27; and Buckeye, $2.12.

•

To Search For Oil in Afghanistan

That Afghanistan may some day be an important oil-producing area is seen in the recent concession granted by the Afghan government to the Inland Exploration Company, subsidiary of the Standard Oil Company of New Jersey. That company has been given a 75-year concession on 270,000 sq. miles of territory heretofore unexplored for oil. Negotiations with the Afghan government were conducted by Charles C. Hart, former United States Minister to Albania and Iran, and Dr. Frederic G. Clapp, geologist and technical expert, with Ogden L. Mills, former secretary of the treasury, as a financial adviser.

Afghanistan, east of Iran, is on a direct line of geological trend from Iraq east by northeastwards to large potential oil areas of northwestern India.

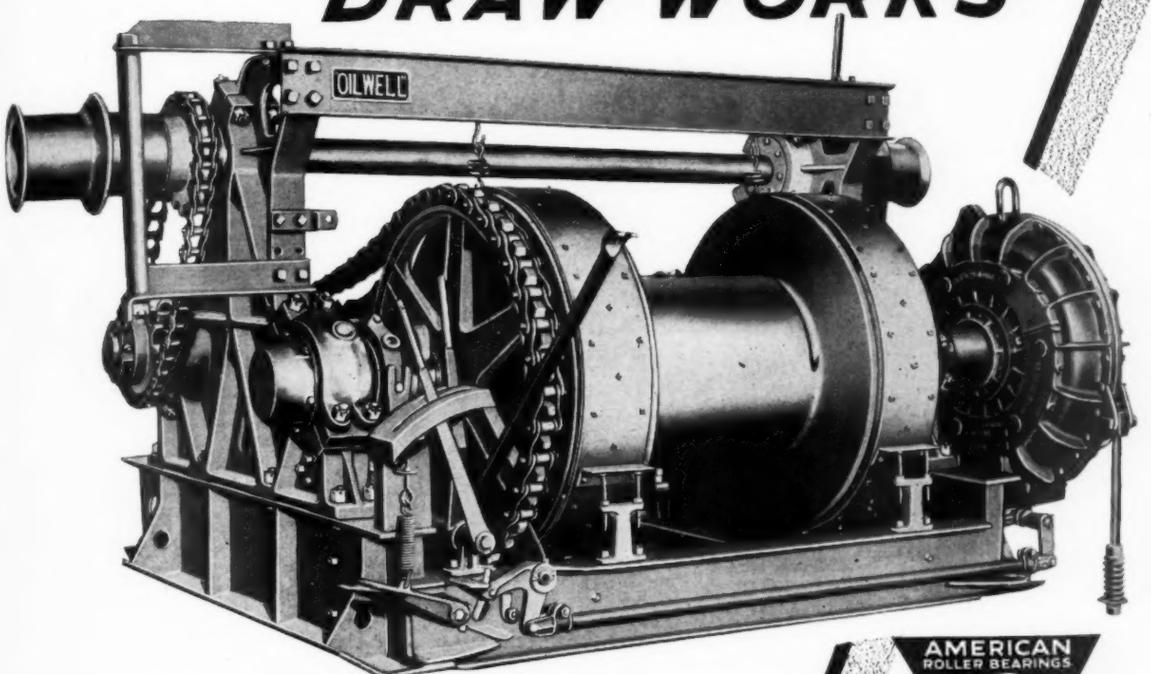
•

"Drip" Gasoline Held Taxable in California

The California Board of Equilization recently has imposed some rather heavy assessments against producers who obtain and use "drip" gasoline from gas lines of their wells. It has long been the custom among certain producers to use this drip gasoline on their leases. The Board maintains that, according to existing laws, any gasoline so obtained and used is subject to the state gasoline tax of three cents per gal., and that the producer must have a license as a distributor of motor vehicle fuel.

The Board of Equilization took its stand after pressure was brought by independent refiners who felt that, inasmuch as their gasoline was being taxed and they were forced to keep a record of their production, it was unfair that drip gasoline should go tax-free. Another influencing factor was that in some instances large volumes of drip gasoline were being sold to refiners as natural gasoline with no records obtainable as to where it originated. As a result the California Board of Equilization is requiring either that drip devices be taken off gas lines or that the producer have a distributor's license and keep the required records.

HUSKY
DRAW WORKS



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The Month's Activities In Refining

Percent Refinery Capacity Operated

Western Division, 59.5 Percent **Central Division, 75.7 Percent** **Eastern Division, 85.5 Percent**

THE CARTER OIL COMPANY is adding two compressors to its gasoline plant in the Fitts pool, Oklahoma. This is the third addition to the plant since its original construction and will make a total of twenty-one 230-hp. engines.

●

The Magnolia Petroleum Company is erecting a natural gasoline plant in the Fitts pool of Pontotoc County, Oklahoma, which will be completed and in operation by the middle of February or the first of March. It will have a capacity of 24,000,000 cu. ft. of gas daily, manufacturing 60,000 gal. of gasoline.

●

Malco Refineries, Inc., Artesia, New Mexico, has let a contract to The Ralph M. Parsons Company for the installation of a clay-treating system for Dubbs cracked gasoline. The installation includes a clay tower with a capacity of 15 tons, a pump house, pumps, after-fractionator, and accessories. The plant is designed to treat 500 bbl. of gasoline daily to 30 color. The Parsons organization completed the construction of a Dubbs cracking unit at the Malco plant last April. This unit has a rated capacity of 700 bbl. daily, but has been running considerably more than that amount.

●

Byrd-Frost, Inc., and the Lucey Petroleum Corporation will construct a 5000-bbl. refinery at Mount Pleasant, Texas, in the Talco field, it has been announced definitely. The general contract already has been awarded to the Frick-Reid Supply Company, and the Universal Oil Products Company has been given a contract for the erection of a Dubbs cracking unit. Plans call for a 50-car loading rack on the refinery site, this to be constructed by the Mosher Steel Company of Dallas. The refinery is expected to be in operation by May 1st.

A catalytic polymerization unit is being installed in the Norwalk, California, refinery of the Wilshire Oil Company, Inc., by engineers of the Universal Oil Products Company. The unit will have a daily capacity of 2,500,000 cu. ft. of gas. Wilshire thus becomes the first independent company in California to install the catalytic polymerization process. Gases from Wilshire's new Dubbs cracking unit will be the charging material for the polymerization plant. There are approximately 2,000,000 cu. ft. of gas daily available for the polymerization unit, but this is expected soon to reach 2,500,000 cu. feet.

●

D. M. Dryden of McPherson, Kansas, and associates, are constructing a refinery southwest of Scott City, in Scott County, western Kansas. The Winkler-Koch Engineering Company has the contract for the erection of the plant, which will operate on crude produced by the Atlantic Refining Company from its shallow pool in Scott County, discovered early in 1936.

●

Additional equipment is being installed in the Sweet Oil Refinery at Wyman, Michigan, that will increase its crude capacity to 3000 bbl. daily. The installations will include a 150-hp. boiler, two 5500-bbl. and three 1000-bbl. tanks, and new recording and control equipment.

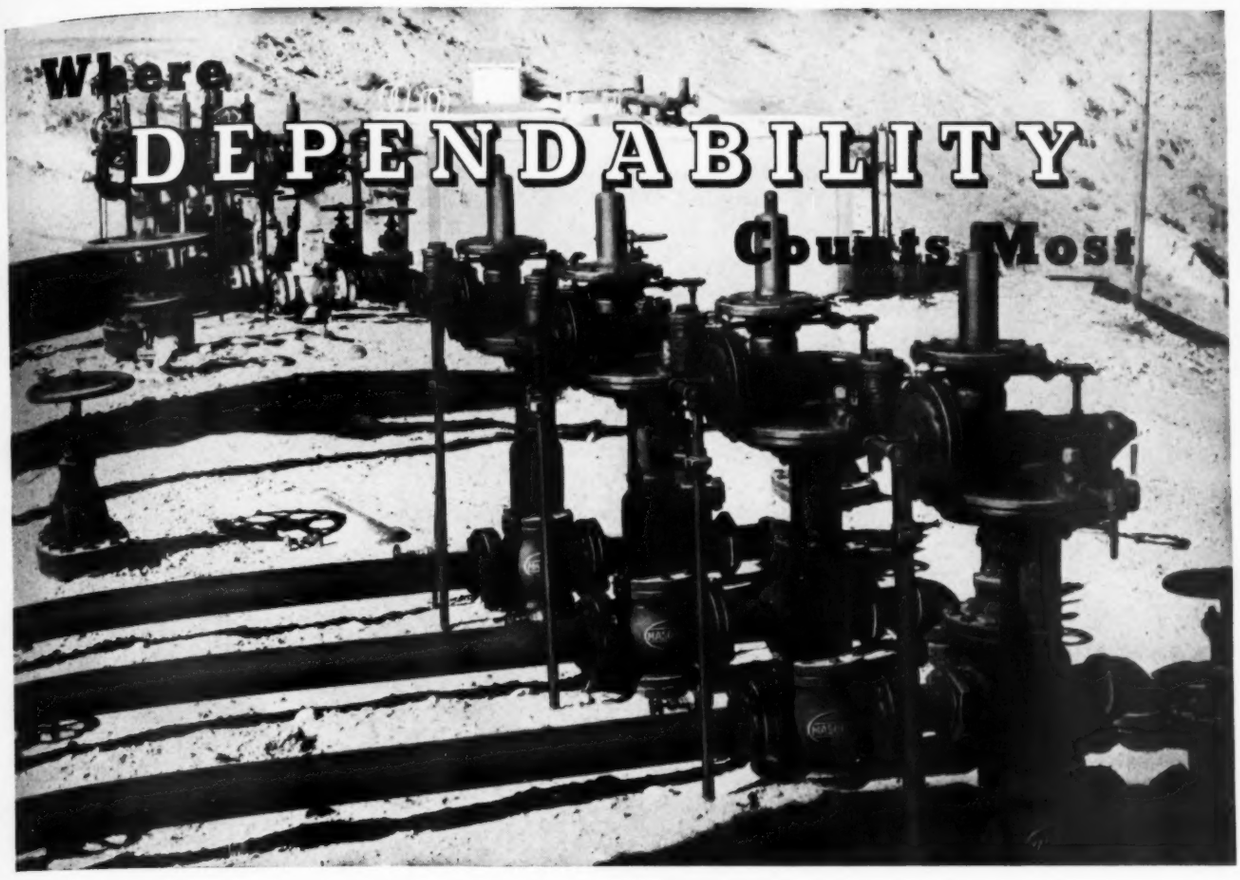
●

Expansion of cracking facilities to the extent of $1,500,000 at its Avon refinery has been announced by Associated Division of Tide Water Associated Oil Company. The principal contract for the cracking unit itself was awarded to Alco Products, Inc., a subsidiary of American Locomotive Company. This equipment will embody all latest developments in cracking designs.

Crude Runs to Stills, Gasoline, and Gas and Fuel Oil Stocks
Week Ended January 2, 1937
A.P.I. Figures
(Figures in Barrels of 42 Gallons Each)

DISTRICT	Percent Potential Capacity Reporting	Daily Avg. Crude Runs to Stills	Percent Operated of Total Capacity Reporting	Total Motor Fuel Stocks Thousands of Bbl.	Gas and Fuel Oil Stocks Thousands of Bbl.
East Coast	100.0	557,000	91.0	14,450	9,375
Appalachian	94.8	104,000	71.2	2,267	644
Ind., Ill., Ky.	96.2	431,000	94.3	9,680	5,543
Okla., Kans., Mo.	84.8	265,000	69.0	5,946	3,184
Inland Texas	48.5	116,000	72.5	1,813	1,783
Texas Gulf	97.0	657,000	92.5	8,991	6,585
La. Gulf	96.4	131,000	80.4	1,522	1,899
No. La.-Ark.	90.0	46,000	63.9	377	536
Rocky Mt.	61.9	36,000	60.0	1,088	746
California	92.6	466,000	59.1	13,009	73,773
Reported	89.9	2,809,000	79.1	59,143	104,068
Est'd Unreported	.....	221,000	.....	3,518	2,262
*EST'D TOTAL U.S. Jan. 2, '37	.....	3,030,000	.....	62,661	106,330
*EST'D TOTAL U.S. Dec. 26, '36	.....	2,995,000	.....	60,873	106,889
U.S. B. of M. *Jan. 2, '36	.....	**2,742,000	.....	57,084	103,759

*Estimated Bureau of Mines basis.
**December, 1935, daily average.



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Latest Activities In The Oil Fields

THE Wertz gas dome in Carbon County, Wyoming, was the scene recently of a discovery that is considered of major proportions. The Sinclair-Wyoming Oil Company brought in its No. 10 flowing 75 bbl. an hour on a drill-stem test. Production is from the Tensleep formation at a total depth of 5883 feet.

A new gas field also has been opened in the same county. On Christmas day the Medicine Bow Oil Company completed its No. 1 Hintze-Government in the Sundance sand at a total depth of 2058 feet. The well produced 25,000,000 cu. ft. of gas daily.

In Yellowstone County, approximately 18 miles southwest of Billings, Montana, R. C. Tarrant has opened a new pool with his No. 1 Sayre. Producing from the Dakota formation, logged at 1010-36 ft., initial production was 100 bbl. during a 24-hour period. Later during an eight-hour test the well made eight bbl. an hour.

Standard Oil Company of California has discovered a new oil field in Kern County, California, 14 miles west of Bakersfield. That company's K.C. 11-1 was completed flowing at a rate of 2626 bbl. of 37-gravity oil daily. The well was drilled to a total depth of 7807 feet. It is in what is known as the Rio Bravo-Rosedale district of Kern County.

In Live Oak County, Texas, on the edge of the old Oakville gas field, a new oil-producing area has been opened by the Ohio Fuel Supply Company with its No. 1 Rosebrock. Upon completion, the well produced two bbl. of oil an hour through 3/8-in. choke, together with 7,000,000 cu. ft. of gas. The well was drilled to a total depth of 2808 ft. in the Pettus sand.

No. 1 Winget of Schoenfeld and Kitch, 11 miles north of the Otis gas field in Rush County, Kansas, has been definitely proven for a producer and opens a new pool. The well, producing from the Lansing lime at a total depth of 3245 ft., swabbed 400 bbl. of oil on a 10-hour test.

In the Raymond area of Rice County, the Rosespring Drilling Company has found production with its No. 1 Mantel. Initially it pumped 418 bbl. of oil from the Siliceous lime and was to be acidized.

Two recent strikes have been recorded for Louisiana's Gulf Coast. No. 1 Harange of the Pan-American Production Company and the Barnsdall Oil Corporation in La Fourche Parish has been completed flowing 14 bbl. of fluid an hour through 1/4-in. choke. The fluid was seven to 20 percent wash water, the rest oil of 33.7 gravity. The well was brought in following gun-perforation at 6930-50 ft. Total depth is 9428 feet.

The other discovery was in St. Landry Parish and was made by the Superior Oil Producing Company. Their No. 1 Savoie flowed 41 bbl. during a period of 15 hours following completion. The test was wrilled to 9428 ft., then plugged back and 7-in. casing set at 6676 feet.

A new Wilcox sand pool has been opened in Noble County, Oklahoma, by the Shell Petroleum Corporation with their No. 1 Moelling. Total depth of the well is 5489 ft. and initial production was 1815 bbl. of oil during a nine-hour test, in addition to 4,000,000 cu. ft. of gas daily. The oil tests 44.7 gravity at a temperature of 57 degrees. The new pool is thre miles north of the Lucien pool.

J. K. Dorrance et al have successfully completed their No. 1 Wing, in the Segno prospect of Polk County, Texas, assuring the Texas Gulf Coast of a new field. The initial flow was 25 bbl. of fluid per hour, 90 percent of which was oil and 10 percent wash water. Production is from the Cockfield formation at a total depth of 5194 feet.

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Signal Hill	1.10
Montana	1.35
Wyoming	1.10
Colorado	1.00-1.10
New Mexico	.75-1.00
Texas	
North Central	.84-1.08
Panhandle	.81-.98
West Texas	.75-.95
Gulf Coast	.85-1.30
Darst Creek	.88-1.22
East Texas	1.15
Kansas	1.10
Oklahoma	1.10
Arkansas	.75-.80
Louisiana	
Gulf Coast	$ .82-1.22
North Louisiana	.86-1.10
Illinois	1.23
Kentucky	1.28
Indiana	1.12
Ohio	
Lima	1.15
Michigan	.70-1.32
Pennsylvania	
Bradford	2.57
Southwest	2.32
Eureka	2.27
Buckeye	2.27
Corning	1.32
West Virginia	1.67
Canada	2.10-2.17

DAILY AVERAGE CRUDE OIL PRODUCTION
Data Supplied by A.P.I.

(Figures in Barrels)

	B. of M. Dept. of Int. Calculations (December)	Week Ended Jan. 2, 1937	Week Ended Nov. 28, 1936	Week Ended Jan. 4, 1936
Oklahoma	567,000	579,900	568,100	462,800
Kansas	155,900	165,850	165,400	137,300
Panhandle Texas		67,450	63,450	59,850
North Texas		63,650	64,650	56,700
West Central Texas		32,900	33,600	25,400
West Texas		167,350	152,600	160,050
East Central Texas		95,550	76,950	49,250
East Texas		447,100	443,150	438,700
Southwest Texas		178,850	170,350	111,450
Coastal Texas		170,500	151,950	167,400
TOTAL TEXAS	1,145,200	1,224,350	1,156,700	1,068,300
North Louisiana		80,850	77,500	43,250
Coastal Louisiana		161,350	157,900	125,650
TOTAL LOUISIANA	204,800	242,200	235,400	168,900
Arkansas	26,800	28,350	27,800	29,500
Eastern	110,600	119,350	113,250	106,350
Michigan	29,300	27,600	29,750	45,700
Wyoming	40,200	44,400	43,500	37,450
Montana	14,300	17,250	17,950	12,550
Colorado	4,500	3,650	3,400	3,900
New Mexico	78,300	86,200	83,300	58,800
TOTAL EAST OF CALIF.	2,376,900	2,539,100	2,444,550	2,131,550
California	553,400	582,300	566,100	671,200
TOTAL U. S.	2,930,300	3,121,400	3,010,650	2,802,750

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With a V-belt drive to a 5 x 10 gear pump, this "Caterpillar" Diesel delivers 250 barrels per hour through a 4-inch discharge into an 8-inch main. Fuel consumption, 2.7 gallons per hour.

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"CATERPILLAR" DIESEL ENGINES
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D17000 . . . . 160 HP.	
D13000 . . . . 125 HP.	D6600 . . . . 60 HP.
D8800 . . . . . 80 HP.	D4400 . . . . 44 HP.

CATERPILLAR DIESEL ENGINES

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CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

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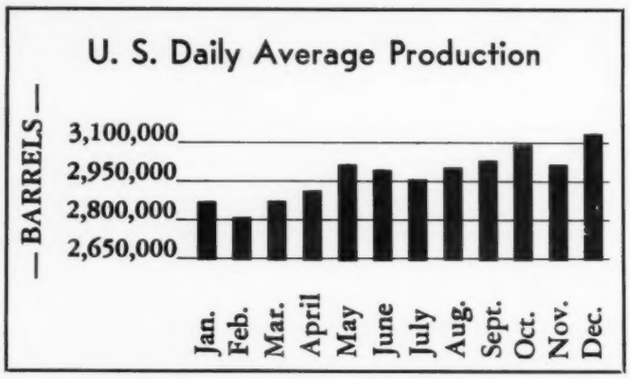

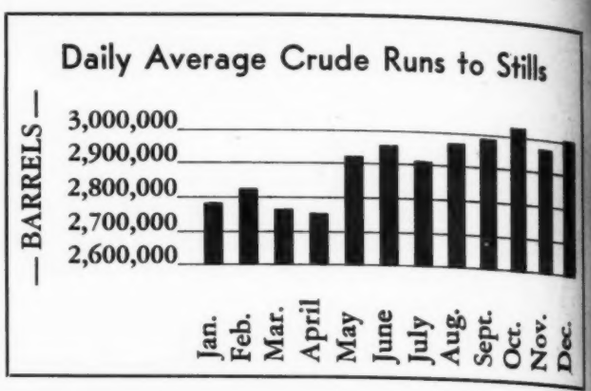

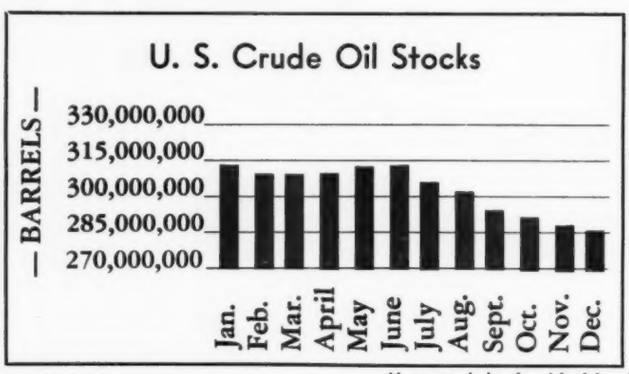

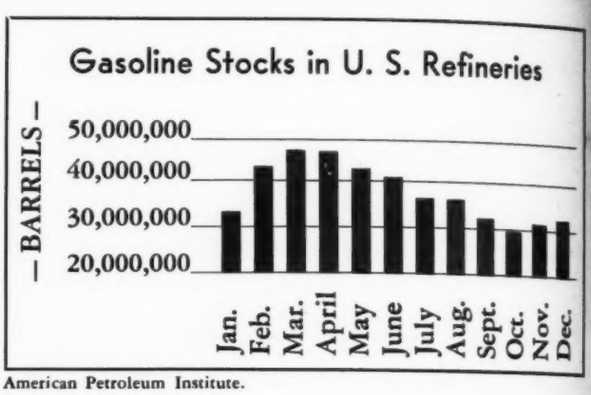

Above statistics furnished by the American Petroleum Institute.

Summarized Operations in Active Fields for December, 1936

Fields	Completions	Producers	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
Texas								
East Texas	192	186	47	78	3500-3700	2	40	Rotary
Duval County	76	62	25	53	1554-2900	2	22	Rotary
Archer County	27	10	4	12	660-1800	1 or 2	40	Rot.-Cab.
Panhandle	73	69	29	133	1700-3900	2	40	Rotary
Refugio County	12	11	4	11	4900-5900	2	38	Rotary
Nueces County	77	64	20	67	3922-5878	2 or 3	21-54	Rotary
San Patricio County	11	8	3	9	3987-6141	2	23-65	Rotary
Talco	45	44	17	22	4230-4361	2	16-24	Rotary
Oklahoma								
Oklahoma City	14	12	2	15	6450-6682	3	39	Rotary
Fitts Pool	51	47	12	71	1800-4488	2 or 3	38	Rotary
Osage County	39	30	5	26	380-2850	2	37.5-40	Rot.-Cab.
Kansas								
McPherson County	10	9	4	18	2900-4300	2	38	Rot.-Cab.
Russell County	35	32	8	50	2926-3435	2 and 5	32-37	Rot.-Cab.
Rice County	31	26	5	45	3222-4085	2 and 5	42-48	Rot.-Cab.
Reno County	11	9	6	19	3300-4375	2 and 5	42-48	Rot.-Cab.
Louisiana-Texas								
Rodessa	46	46	8	72	5950-6450	3	39	Rotary
California								
Kettleman Hills	1	1	2	18	8300-8730	3 or 4	40	Rotary
Midway-Sunset	12	11	14	23	1400-3100	1 and 2	11-30	Rot.-Cab.
Mountain View	6	6	4	11	5200-6000	2	20-40	Rotary

Field Activities by States for December, 1936

State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1935 (In Barrels)
	December	November	December	November	December	November	December	November	December	November	
Arkansas	7	5	4	0	11	10	10	9	39	36	11,140,750
California	81	66	67	56	107	75	94	108	249	256	207,899,480
Colorado	2	5	0	3	....	....	3	3	29	25	1,565,150
Illinois	11	9	4	5	....	....	31	26	9	18	4,352,000
Indiana	....	5	....	4	....	....	4	3	26	23	762,000
Kansas	215	144	161	110	219	150	49	50	341	348	53,013,450
Kentucky	24	10	12	4	....	....	17	16	42	45	4,860,000
Louisiana	92	79	59	61	72	64	24	32	165	168	50,299,950
Michigan	76	48	41	29	59	76	68	81	128	143	15,661,350
Mississippi	....	2	....	1	....	....	3	4	10	11	Gas Prod.
Montana	17	24	16	19	....	....	3	4	52	60	4,304,100
New Mexico	58	39	57	38	....	....	17	8	121	110	19,195,500
New York	....	....	....	....	....	....	1	2	5	6	3,191,900
Ohio	161	169	125	139	....	....	81	48	236	176	4,234,000
Oklahoma	287	210	219	157	288	216	61	76	465	492	181,152,050
Pennsylvania	....	....	....	....	....	....	36	31	149	136	14,478,000
Texas	1225	1038	958	798	1185	1248	451	501	1396	1473	377,747,205
West Virginia	32	21	30	20	....	....	44	51	193	202	3,818,400
Wyoming	20	14	13	11	....	....	4	6	54	58	13,390,100
Total	2308	1888	1766	1455	1941	1839	1466	1059	3709	3786	970,995,385

Here is shown the colorful Colonel Ed. Walters conducting one of the Osage sales under the famous "million dollar oak" at Pawhuska, Oklahoma. The first of these sales took place November 11, 1912 and paid the tribe $39,436. In the twenty-five years since, their income from these sales is estimated totaling $113,572,000.00

"Going—going—gone!" as uttered by Colonel Ed. Walters, famed auctioneer of oil rights, spelled huge wealth for the great Osage Tribe. But, the "going-going—gone" of a dying oil well is another story. DOWELL, through sound methods of Acidizing is prolonging production for thousands of producers—pouring a combined wealth totaling millions into their pockets.

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OIL AND GAS WELL CHEMICAL SERVICE

Progress of Major Pipe Line Work

THE Shell Pipe Line Company has completed its 75-mile 10-in. oil line in West Texas, extending from Wink to McCamey. The new line parallels two 6-in. lines already in use. No new booster stations were constructed, those already in service being sufficient to move the added load. Crude is from the Hendricks and other near-by fields of West Texas and New Mexico. It is boosted to McCamey from where it is sent either to Houston, Texas, or Wood River, Illinois. The line was electric welded over its entire length.

•

The Humble Pipe Line Company has started construction of three 8-in. loops, totaling 45 miles, between its Wink station and the terminal at Kemper, West Texas. When completed the capacity of the Wink station will be increased by 10,000 bbl. daily. One loop 21 miles in length will extend from the Wink station south toward Crane. A 15-mile loop will be laid between McCamey and Kempner, and the third loop will be between Crane and McCamey.

•

Magnolia Pipe Line Company's 85-mile 8-in. oil line from its Tilden station on the Duval-Karnes County, Texas, line to Corpus Christi is nearing completion and is expected to be in operation shortly. The Mitchell Stewart Construction Company of Dallas is in charge of the work. The line is being welded, and soil tests are being made over the entire length of the line with adequate means taken to prevent corrosion to the pipe. Two additional 80,000-bbl. tanks are being erected at the Tilden station, and later an intermediate station between Tilden and Corpus Christi may be constructed.

•

Stanolind Pipe Line Company has awarded a contract to Williams Brothers, Tulsa, Oklahoma, for the laying of an 8-in. oil line from its Webster Station to Texas City, Texas, a distance of 20 miles. Construction work began January 5th. The line is being oxy-acetylene welded by the Lindeweld method.

•

Several short pipe lines are being laid and contemplated in Michigan. The Simrall Pipe Line Corporation has under construction a 12-mile line from the new Clayton Township pool, Arenac County, to the Ogemaw fields, where it will tie into the company's existing system. The McClanahan Pipe Line Company has completed a 5-mile line from Clayton Township to Prescott.

The Michigan Public Utilities Commission has granted the Gas Corporation of Michigan permission to construct a gas line from Winfield, Montcalm County, to Greenville, a distance of 15 miles, and work on this project is expected to begin soon.

•

Three new pumping stations have been constructed by the Humble Pipe Line Company on its 8-in. trunk line that connects the Talco field with the company's Longview-Louisiana line. The stations are installed at 16-mile intervals.

H. C. Price, Inc., Bartlesville, Oklahoma, electric welding contractors, have been awarded the following contracts for electric welding of pipe lines:

From the Apex Construction Company, 72 miles of 10-in. being laid for the Humble Pipe Line Company near Port Arthur, Texas.

From Phillips Petroleum Company, 31 miles of 24-in. gas line being laid near Borger, Texas.

•

Two oil lines will be laid for the Continental Pipe Line Company by Williams Brothers of Tulsa, Oklahoma. One, a 16-mile 6-in. line will extend from Guthrie to Crescent, Oklahoma; the other, a 5½-mile 4-in. line, will run from Orlando to Lucien, Oklahoma. Both lines will be oxy-acetylene welded by the Lindeweld method. In addition to taking the Continental's own production, crude also will be run from wells of the Gulf Oil Corporation, the latter being delivered to the Gulf's line at Ponca City, Oklahoma.

•

Crude is now moving through the Humble Pipe Line Company's new 8-in. and 4-in. Flour Bluff pipe line in Nueces County. The new 18½-mile carrier connects the Flour Bluff field with the company's Viola station, from where the crude oil is sent to Harbor Island and Ingleside. As a part of the project a 55,000-bbl. storage tank has been erected in the field and an 80,000-bbl. tank at the Viola station.

•

Recently the Humble Pipe Line Company placed in operation a 21½-mile 6-in. line extending from the Heyser field of Calhoun County to the Quintana station in the Tomoconnor field; as well as a short line from the Plymouth and Taft fields to the Quintana station.

•

A natural gas gathering system has been completed in the Mercedes pool of Hidalgo County, Texas. All wells in the field are owned by the Union Sulphur Company. The gathering system connects with a new 6-in. main line leading from the field to a point near the main valley line of the Rio Grande Valley Gas Company, to which it is expected to be connected.

•

The Shamrock Oil and Gas Company will lay a 20-in. gas line from its Dumas plant in the Texas Panhandle southeast toward Borger, Texas, a distance of 14 miles. Maddux Brothers have been given the construction contract, and the line will be oxy-acetylene welded.

•

The Cities Service Gas Company is constructing an 8-in. gas line in the vicinity of Cushing, Oklahoma. The line, seven miles in length, is being laid of reconditioned pipe and the joints are being oxy-acetylene welded by the Lindeweld method.

THE Petroleum Engineer

JANUARY, 1937

Fuel Pressure Waves

Their effect on airless fuel injection systems of the Diesel engine—a discussion of fuel injection valves and how they affect performance of modern high-speed Diesel engines

By CHAS. C. KEANE

THE manufacture of fuel pumps and injection valves for solid injection engines demands infinite care and superior workmanship to compensate for the high pressure these mechanisms are called upon to withstand. Modern fuel pumps and injection valves are packingless, the pump consisting of a hardened plunger and barrel with the necessary valves and working parts being carefully ground together.

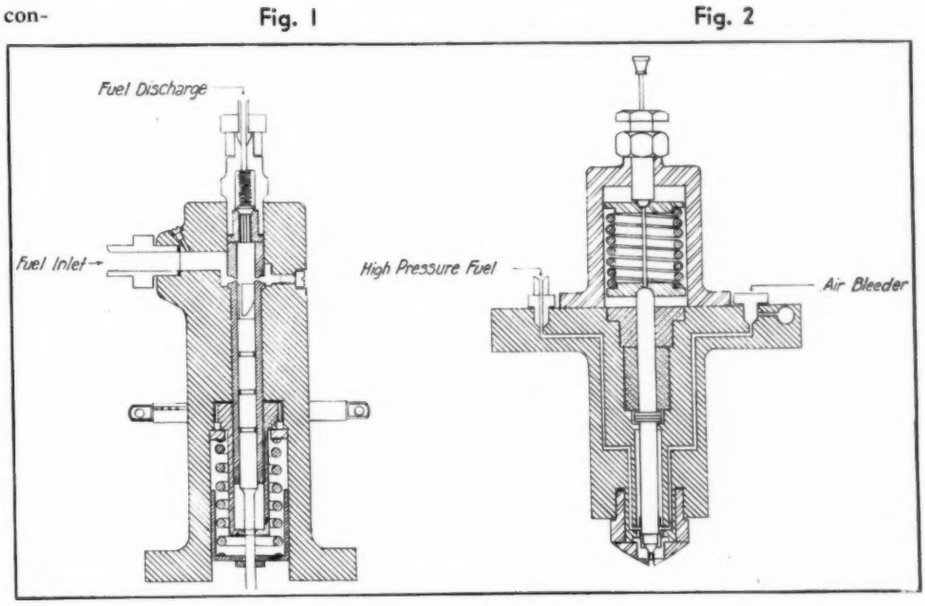
Fig. 1 shows a modern fuel pump without suction valves, the stroke being constant. Fuel is supplied to the suction side at a gauge pressure of 10 to 15 lb. per sq. in. in order to avoid air entrainment and separation of the supply column. The fuel supply is governed by rotating the pump plunger by means of a rack and pinion motion, operating directly through linkage from the engine governor, the fuel supply being cut off by a helix

Fig. 1. Fuel pump without suction valves, the stroke being constant

Fig. 2. Injection valve, spring-loaded, incorporating a stop collar that limits the valve travel, and operated by the pressure impulses imparted to the fuel column on the discharge side of the fuel pump

Fig. 1

Fig. 2



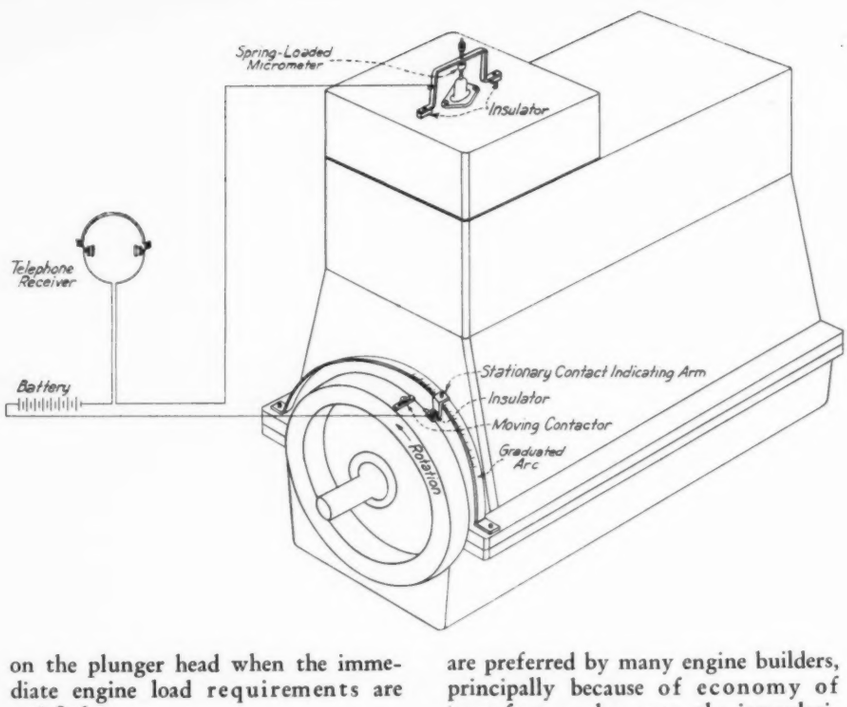


Fig. 3. Device for measuring the intensity of fuel pressure waves

on the plunger head when the immediate engine load requirements are satisfied.

The injection valve shown in Fig. 2 is spring-loaded, incorporates a stop collar limiting the valve travel, and is operated by the pressure impulses imparted to the fuel column on the discharge side of the fuel pump. These impulses are positively timed, to open the fuel valve at the proper instant, by the fuel pump cam. The design of injection valve illustrated has proven very successful for the proper atomization of low-gravity fuels prior to combustion. The valve opening is of very short duration when this quality fuel oil is burned. The cut-off is instantaneous and effective without afterdrip. Open-type nozzles that depend on the fuel pump discharge valve to prevent disruption of the discharge column are not satisfactory, owing to the sluggishness of the pressure transmitted through the fuel piping, permitting the fuel to drip freely through the injection valve holes before atomization pressure is built up.

The fuel piping from the fuel pump to the injection valve should be as short as possible to avoid elasticity in the piping and particularly in the pressure wave inertia transmitted to the fuel at the beginning of the pump stroke. Some manufacturers compensate for these irregularities with a design of integral fuel pump and injection valve that apparently gives very successful results.

Fuel pumps constructed in groups are preferred by many engine builders, principally because of economy of manufacture; however, the irregularities pertaining to unequal length of fuel pump discharge lines to the respective injection valves, as previously mentioned, again enters to restrict the promiscuous use of this design.

Adjustment of the injection valves is determined by the injection cam profile, the diameter, angular relationship, and number of atomizer holes, as well as the spring compression.

An apparatus sometimes utilized for adjusting injection valves is illustrated in Fig. 3. The mechanism is designed with a view to obtaining a diagram of the injection valve lift and timing in relationship to the angular position of the crankshaft. This instrument is preferred to pressure indicators upon which the accelerating forces act too violently and the sensitivity of optical indicators disqualifies them as impractical.

The injection valve under discussion is provided with an extension tip, the straight-line motions of which are brought in contact with a steel spring by adjustment of a micrometer screw. This screw is electrically insulated and connected through a head telephone to a 6-volt battery or approximate d-c. circuit. The other pole of the battery is connected to a flat steel spring fitted to, but insulated from, a semi-circular clamp screw that is movable on a graduated scale plotted in degrees, the center point of which is zero and is used to indicate the crank upper dead center of the particular injection valve under consideration.

This graduated scale is a 180-deg. arc bolted to the engine frame. Attached to the perimeter of a flywheel rotating with the crankshaft, and in the same vertical plane as the center line of the crank pin of the cylinder, is a contact finger that closes one of the battery conductors each revolution; when the flywheel contact finger and the injection valve extension contactor, by adjustment of the micrometer head screw, close their respective circuits in perfect synchronism the completed circuit is indicated by a snap in the telephone receiver.

The linear dimension of the valve movement is indicated by the microm-

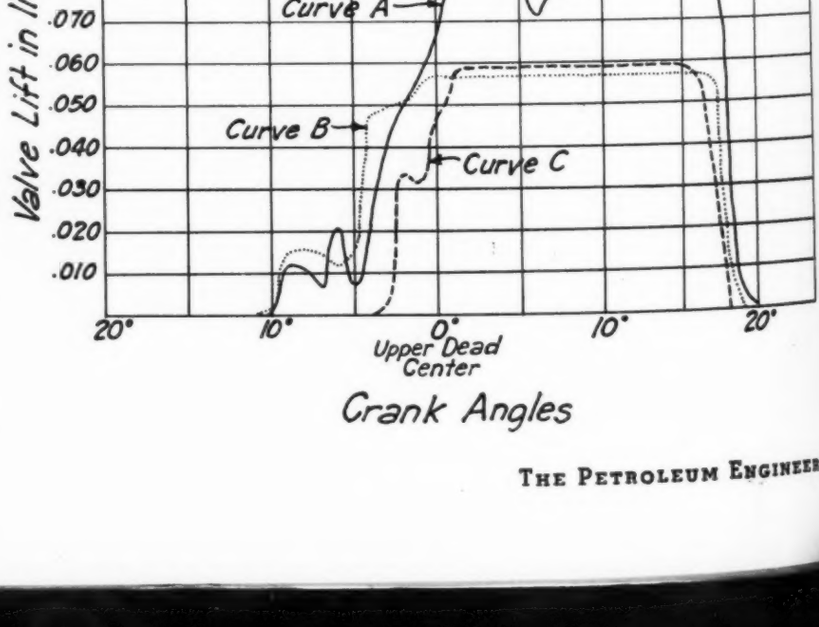


Fig. 4. Curves showing valve lift under varying conditions

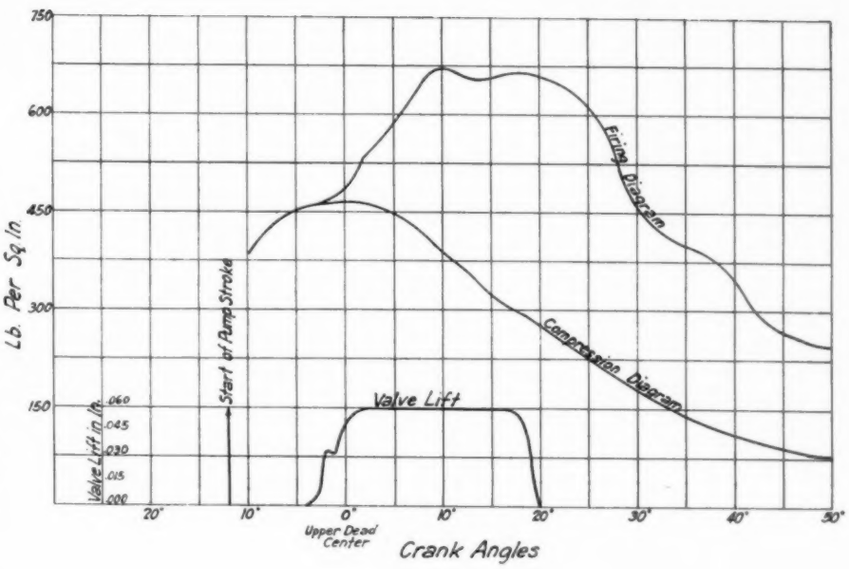


Fig. 5. Out-of-phase pressure diagrams and corresponding valve lift diagram. M.I.P. 105-lb. per sq. inch

eter head; the crank angle pertaining to this particular movement is indicated by the semi-circular graduated arc-indicating screw.

The position of the crank being known, the lift of the injection valve needle with respect to the crank position is determined easily and a curve plotted of the needle movement. The crank position can be set up as abscissas and the intensity of the needle movements, as ascertained by the micrometer, set up as ordinates. The injection period is outlined by the diagram and from it analytical observations can be made pertaining to any particular position of the crank. Fluctuations in the fuel stream of the pressure piping also can be determined.

In the graphical illustration Fig. 4, three curves are shown. Curve A is from a valve without a limiting stop, showing the complete pressure inertia of the fuel for the duration of the injection period, the compression of the injection valve spring being known. Curve B is plotted from a valve with a stop, the atomizer holes, the spring compression, and cam profile being incorrectly adjusted. Curve C indicates the movement of a fuel valve with correct adjustment and even fuel injection.

It will be noted from curve A that the valve lift varies considerably during the period of time when the maximum quantity of the fuel charge is being injected. This irregular movement is directly attributed to a free period of vibration originating in the fuel valve spring that, when superimposed upon the oscillation produced in the fuel line by the cam impulse, causes violent fluctuating of the fuel valve. This condition is particularly accentuated when a stop to limit the travel of the fuel valve is omitted.

The valve lift corresponding to a crank angle of two deg. past upper dead center is approximately .084 in.; at six deg. past dead center the valve lift has dropped .013 in., now being .071; from the 6-deg. point to the 13-deg. point a constant increase is evident in the valve lift, the maximum opening of .101 in. being attained at 13 degrees. The opening remains constant at .100 in. from 13.5 to 15 deg., and from 15 deg. to the final closing at 20 deg. the lift decreases rapidly.

It is evident that the combustion of fuel injected under such varying velocities cannot be conducive to the best thermal conditions. The area of the fuel orifice presented to the fuel pressure under these conditions varies as much as 30 percent.

Curve B shows a decided improvement over curve A, the valve lift being constant from upper dead center to 16 deg. past upper dead center; however, improper coördination of the valve spring, atomizer holes, and cam profile prevent the desired effect. It will be noted that the valve opening attains 86 percent of its maximum opening four deg. before upper dead center is reached, a point at which the valve lift plotted in curve C begins. Discussion pertinent to curve C would be superfluous; it is evident that this curve contour plotted from the valve lift approaches the ideal.

Fig. 5 indicates the relationship of the fuel valve opening to the out-of-phase firing diagram. The compression diagram is superimposed for comparison with the firing diagram relative to pressure increase.

Proper maintenance of injection valves cannot be stressed too heavily. Slipshod methods should be avoided, as they inevitably lead to poor performance, particularly in modern high-speed Diesel engines.

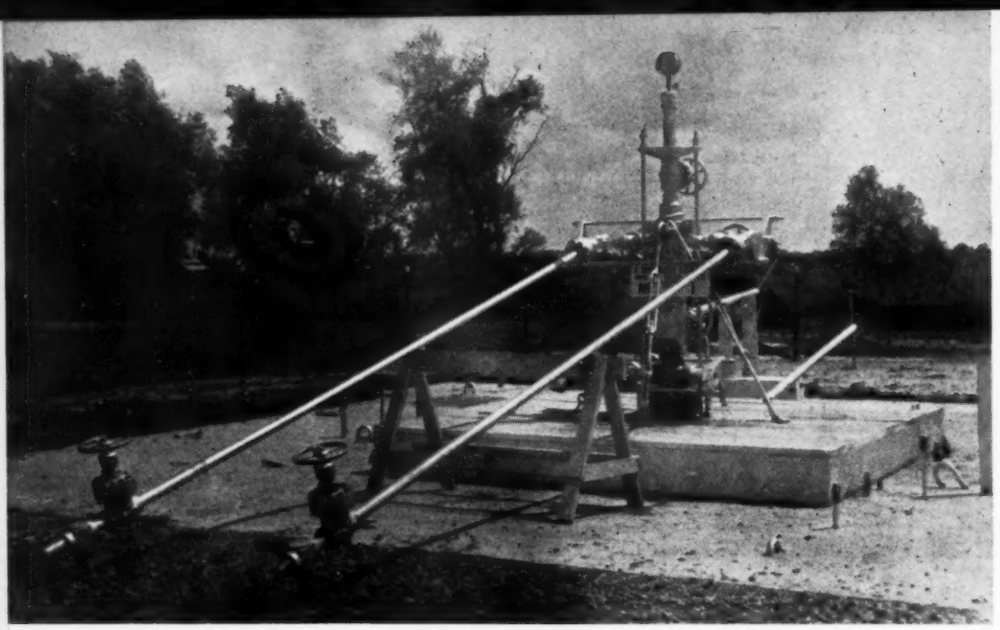
Solvent Extraction Refining Petroleum Lubricants

SOLVENT extraction refining of petroleum lubricants has made possible the commercial production of greatly improved lubricants from abundant sources at a saving of millions of dollars a year, Dr. John W. Poole, New York petroleum technologist, declared at a Symposium on Absorption and Extraction sponsored by the American Chemical Society's Division of Industrial and Engineering Chemistry at Columbia University, December 28.

"There can be little doubt that solvent extraction refining represents the greatest advance of all time in the technology of petroleum lubricants," Dr. Poole said, "Years of unobstrusive research in this field have resulted in great improvement in the quality of mineral oil lubricants, and sources previously productive of inferior oils only have been made available for the production of types superior even to what were heretofore the highest grade of premium oils.

"The technology involved consists of mixing with a raw lubricating oil a quantity of a liquid capable of dissolving within itself those constituents of the oil that cause it to lose body rapidly as temperature is increased. Undesirable sulphur compounds and substances that tend to form sludge or deposit carbon also are dissolved by the solvent. The desirable constituents of the oil, on the other hand, are dissolved to a lesser degree.

"The operation can be compared broadly to the washing of dirty clothes, wherein a mixture of soap and water removes the dirt but leaves the cleansed materials behind. There is, however, one very important point of difference between lubricant washing and the handling of the family wash: very considerable quantities of the good oil also dissolve in the solvent."



Christmas tree on T. Ortego No. 1, the discovery well in the Tepetate field

By

K. C. SCLATER

Well-Planned Program Marks De

Coordination of drilling activities and close observation of wells on production has aided in overcoming difficult problems of well completion and the conservation of gas energy in this deep field

FIELD development and production practices that are among the most advanced of their kind are to be found in the Tepetate, or Basile, field, 18 miles north of the town of Jennings in Southern Louisiana. This statement applies not only to the entire field but to every phase of field operations from spudding-in of wells to delivery of oil to the pipe line. Several months ago in these pages an article on the new crude stabilization plant in this field was published in which attention was called to the departure from standard practice this project involved, particularly in regard to the details of design, type of operation, and the source and measurement of crude oil and gas for the plant. Besides stabilization of the crude production at the well, other departures from standard field practice are followed also in the drilling and completion of wells.

The putting into execution of a well-planned program of development in this field has been facilitated by the fact that all the productive acreage is owned and developed by one company —the Continental Oil Company. Thus far the development program adopted has been highly effective and probably will be far-reaching in its results. Not only have development costs been held to a minimum, but conservation of gas and gas energy assure a greatly extended life for the field, high ultimate recovery, and low production costs.

The discovery well was brought in August, 1935, and by the time this appears in print a total of 45 wells at least will have been completed. This represents a total footage drilled of close to 375,000 ft., assuming a total average depth per well of 8325 feet. A spacing of one well to 20 acres obtains in the field.

Much thought has been given to expediting the drilling of wells with a minimum of "lost motion." Proper completion and low drilling costs are the ends sought. All wells are drilled and completed on contract. Two drilling contractors are employed and each has two rotary rigs running continuously. The average completion time per well is 30 days; one well in the field was completed at a depth of 8320 ft. and producing oil within 24 days from the time it was spudded in.

Construction of derrick foundations, which are of concrete, and the erection and dismantling of derricks and steel sub-structures, also are carried out under contract. The contractor for this service is a prominent construction firm skilled in concrete construction and structural steel work.

The field work is so organized that the construction contractor keeps far ahead of the drilling crews in order that there shall be no delays. As soon as a well is completed the drilling crew moves without delay to a new location, where, with everything already in readiness, rigging-up is carried out with the utmost speed and economy of labor. Moving and rigging-up ready to spud-in usually is completed within a period of 72 hours. A new location, with foundations set and derrick erected, always is in readiness.

Drilling offers no special difficulties. The formations, except for an occasional hard shell, are soft and easy to drill. Drag type 3-way bits are used almost entirely; only occasionally are

Cellar hook-up on drilling well showing cellar control valve (or blowout preventer) above and drilling gate valve below

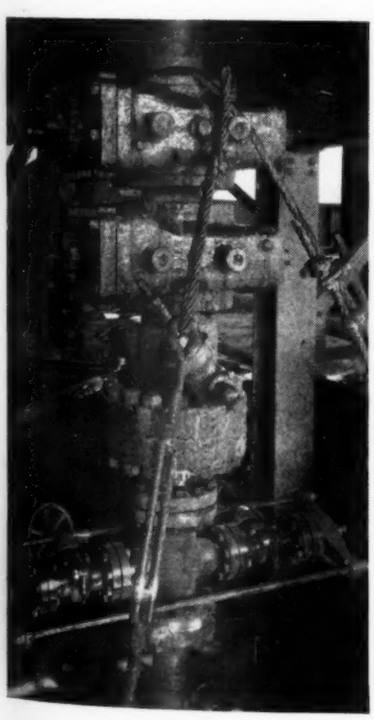
Christmas tree and flow line connections were installed on this well before the standard design shown in sketch on page 36 was developed

Development of Tepetate Field

rock bits employed. An examination of the records of ten wells drilled showed an average of 16 bits to the well. Drilling from the surface is begun with a 16-in. hole, which is carried to an average depth of 1500 ft., at which point a string of 10¾-in. 40.50-lb. grade D seamless casing is set and cemented with 850 sacks of cement. The cement is allowed to set 48 hours before drilling is resumed. A 9⅝-in. hole is then carried to bottom, where a string of 5¾-in. 22.50-lb. grade D seamless casing is set and cemented with 500 sacks of cement. This is allowed to set at least 72 hours before the plugs are drilled.

From the surface all the way down 4½-in. 16.60-lb. drill pipe is used; 3-in. drill pipe is used for drilling the plugs. Typical of the drill stem make-up is that in use by one of the contractors, who uses on the bottom of his 4½-in. drill pipe: An 8¼-in. drill collar 50 ft. long, and above that three joints of 6-in. 75-lb. hydraulic drill pipe and 80 ft. of 4½-in. 45-lb. hydraulic drill pipe. Holes are tested for vertical at least every 500 ft., and sometimes at intervals of 250 ft. or less as occasion demands.

Drilling mud of 9½ to 10 lb. per gallon is used to drill to the top of the sand. Before drilling-in the mud in the hole is entirely reconditioned and the weight brought up to 10.8 to 11.4 lb. per gallon and a viscosity of 36 to 38; usually from 350 to 500 sacks of Baroco and 20 sacks of Aquagel are added to condition the mud. An engineer, solely to watch the mud, is present during drilling-in. The greatest care is exercised and extra precautions taken to avoid a blow-out while drilling-in, because of a gas cap and a high reservoir pressure, which, it has been learned, is well in excess of 4000 lb. per sq. inch. If the distance is not too great, mud is transferred from one rig to another to be used over again; otherwise, a batch of new mud is made at the new location. Drilling is carried on at all times through a master gate valve and a blow-out preventer.



Here is shown a drilling hook-up of 6000-lb. test and consisting of a mud cross, a cellar control gate valve complete with shut-off rams, and a cellar control gate valve complete with drill pipe rams. These connections are set on lower half of Christmas tree. The well is hooked-up for drilling out cement plug and running tubing

Drilling-in of the well, unlike drilling from the surface to the top of the sand, is an unusually ticklish problem. Besides the high pressure and great depth, there are critical physical factors in the reservoir to contend with. The productive sand is comparatively thin, having a maximum thickness of only 28 ft., 25 percent of which is shale intercalations; gas is immediately above, and water immediately below, the oil.

The average surface elevation of the field is only 50 ft. above sea level. The average depth to top of oil is 8304 ft., and to the water table 8332 feet. The average depth to the top of gas cap varies according to the position of the well on the structure. In a well near the crest the top of the gas cap was found at a depth of 8229 feet.

These gas, oil, and water levels having been subjected to careful checking as development has proceeded, it has become the practice, for safety, to complete wells at a depth of 12 to 14 ft. above the water table. This is the closest distance to the water table that is attempted in completing wells. At this depth, with a sand thickness of only 28 ft. or less, and high-pressure gas in large volume immediately above and water immediately below the oil, there is no room for error while drilling-in. Measurements must be precise and drilling must proceed cautiously.

Cores usually are taken between 7700 ft. and 7900 ft. and again at depths of 8300 ft. or thereabouts depending on the casing point in the well. The greatest care has to be exercised in coring in order to obtain good recovery, because the formations on the whole are relatively soft and fri-

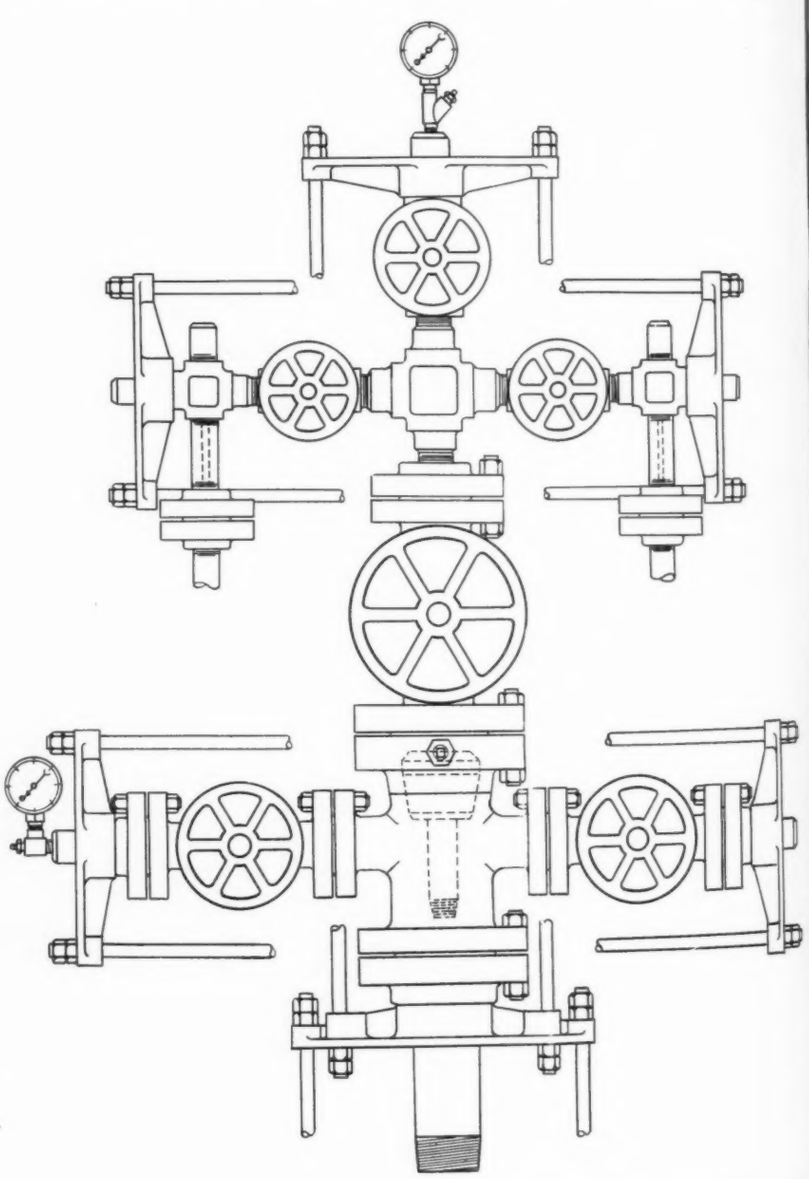
Derrick foundation with steel substructure and derrick erected and about ready for the drilling crew to begin rigging up

able. A coring tool with a non-rotating inner barrel is employed in coring operations and has been found to give good recovery under the difficult coring conditions encountered.

After coring, drilling is suspended in order to prepare the hole for making a Schlumberger survey. The hole is reamed and washed, after which the survey is made, the whole job usually taking from seven to eight hours. Having drilled to the desired depth, the placing of a liner of the proper length opposite the required position in the sand is another phase of well completion in this field calling for more than ordinary care and skill. The present practice of completing wells, and one that has been adopted as standard, is the outcome of a close study of subsurface conditions and observation of the producing characteristics of the first wells completed in the field. The method of completion really has gone through a process of evolution.

The early wells were completed with a 7-in. oil string to the top of the sand, and a screen pipe and liner of smaller diameter in the sand. High gas-oil ratios necessitated a change to another method. This consisted of running a blank liner on bottom of the oil string and gun-perforating opposite the sand. Even with a limited number of perforations, this second method still resulted in gas-oil ratios that were too high. It was determined that the great permeability of the formation, combined with its loose unconsolidated nature, required the use of a liner with small slots of limited total area. In addition, the slotted liner had to be accurately positioned in the oil sand; that is, about midway between the oil-gas and oil-water levels. This exacting requirement led to the use of the full-hole cementer, together with a short length of Howco cement-lined slotted pipe. Experience has shown that this method of completion has given lower gas-oil ratios than any yet tried and therefore came to be adopted as standard. The openings in the slotted pipe are .012-in. horizontal slots, and the total area of the slots is not allowed to exceed the cross-sectional area of the oil string.

The slotted pipe and full-hole cementer with a cement guide shoe on bottom are run on 5¾-in. 22.50-lb. grade D seamless casing as shown in the accompanying illustration. Running the oil string and cementing usually takes 12 hours with a crew of ten men. As much as 5600 ft. of casing has been run in eight hours. An average of 36 minutes is taken to run the cement in the oil string and 12 minutes more to "catch" the plugs.



Sketch showing design of Christmas tree of 6000-lb. test pressure developed for standard use on wells in the Tepetate field

These slotted liners are very short, varying in length on the average from 18 to 48 in. depending on the core information and sand penetration. The difficulty of setting so short a liner with reasonable accuracy at a depth of 8300 ft. obviously is great.

In setting the oil string the cement, with a plug ahead of it, is pumped down the hole. When the plug strikes the full-hole cementing tool it shears the pins in a sleeve, which slides slightly downward and uncovers holes through which the cement passes on up and outside the casing. The plug, held in the full-hole cementing tool, prevents the cement from passing downward through and around the guide shoe; thus the cement is prevented from entering the space between the slotted pipe and face of the sand. During the time the cement is setting the drilling crew breaks down the 4½-in. drill pipe and lays it on the rack. The 3-in. drill pipe is then made up and stacked in the derrick preparatory to drilling the plugs; also the lower part of the Christmas tree, surmounted by a blow-out preventer equipped with small rams, is connected to the casing.

After drilling out the plugs and also the cement lining in the slotted pipe, an operation that ordinarily takes about two hours, a string of 2-in. external upset tubing is run and suspended 250 ft. or more off bottom, the depth depending on the position of the well on the structure. The bottom joint of the tubing is bull-plugged and perforated. A tubing catcher also is run on the tubing on the fourth or fifth joint from bottom. It takes from six to seven hours on the average to run the tubing. The tubing is suspended on a tubing hanger in the lower part of the Christmas tree as shown on the accompanying drawing. With the tubing securely suspended the upper part of the Christmas tree is connected up preparatory to bringing the well in. The Christmas tree, which is tested to 6000-lb. pressure, has a special master gate valve with flanges different at each end to permit flanging up without the use of spools or nipples. All flange joints in the Christmas tree are fitted with soft-iron ring gaskets. The valve is of the Venturi type with flow throats to keep the fluid stream off the seats and eliminate cutting. This design, which has been adopted as standard, has evolved from experience in the field. Some of these hook-ups in the field are shown in the accompanying illustrations.

To bring in the well, the drilling mud is washed out by pumping water down the tubing for two hours, or longer if necessary. The well is caused to flow by injecting high-pressure gas into the tubing with water. Gas for this purpose is obtained from Ortego No. 1, the discovery well, at a pressure of 1200 lb., the arrangement of separators and connections at this well having been worked out to accomplish this with the least delay.

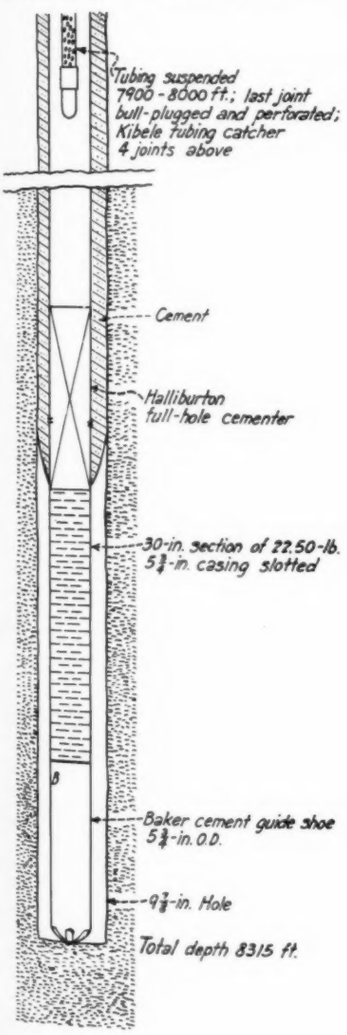
After the well begins to flow, the oil and gas are received into a spare separator and tank for a few hours until the production is free of drilling mud and water, after which the well is switched into the high-pressure lease separator at the crude stabilization plant.

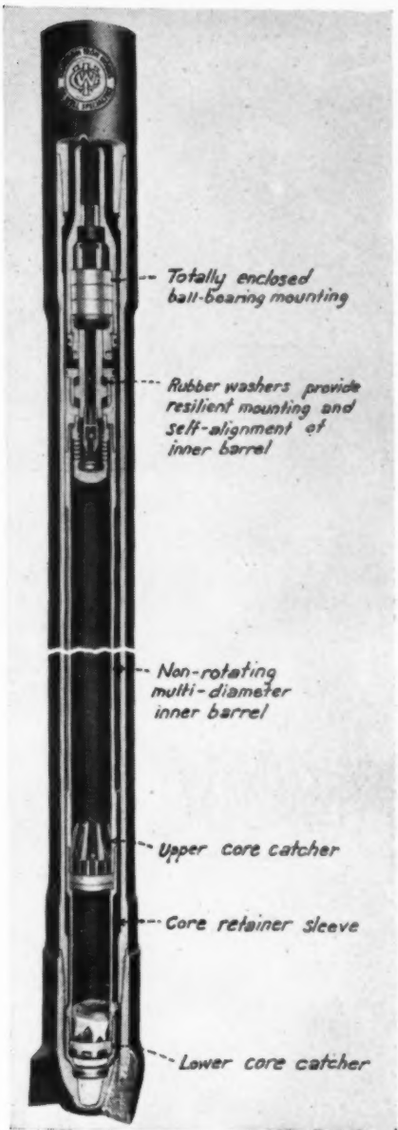
Steel derricks 136 ft. high, 30-ft. base, and designed for 870,000 lb. load according to A.P.I. standards, are used for drilling. After completion of a well, the derrick is dismantled and removed to a new location. As all wells brought in are producing by natural flow, no derricks are used on the producing wells; investment in derricks for producing wells therefore will be deferred until the need for them arises.

Drilling activities in this field and all operations in connection therewith have been so well planned that a high degree of coördination has resulted that has eliminated unnecessary duplication and wasted effort so often prevalent during the early stages of field development.

(NOTE: Production practices in this field will be discussed in an article to appear in the February issue.—The Editor.)

Sketch showing typical method of well completion in the Tepetate field


Tubing suspended 7900 - 8000 ft.; last joint bull-plugged and perforated; Kibele tubing catcher 4 joints above
Cement
Halliburton full-hole cementer
30-in. section of 22.50-lb. 5¾-in. casing slotted
Baker cement guide shoe 5¾-in. O.D.
9⅞-in. Hole
Total depth 8315 ft.


Totally enclosed ball-bearing mounting
Rubber washers provide resilient mounting and self-alignment of inner barrel
Non-rotating multi-diameter inner barrel
Upper core catcher
Core retainer sleeve
Lower core catcher

Cross section of rotary core barrel in use in Tepetate field, where good recovery is hard to obtain because of the soft and friable nature of the formation

One of the central reconditioning yards. These were spaced 15 miles apart

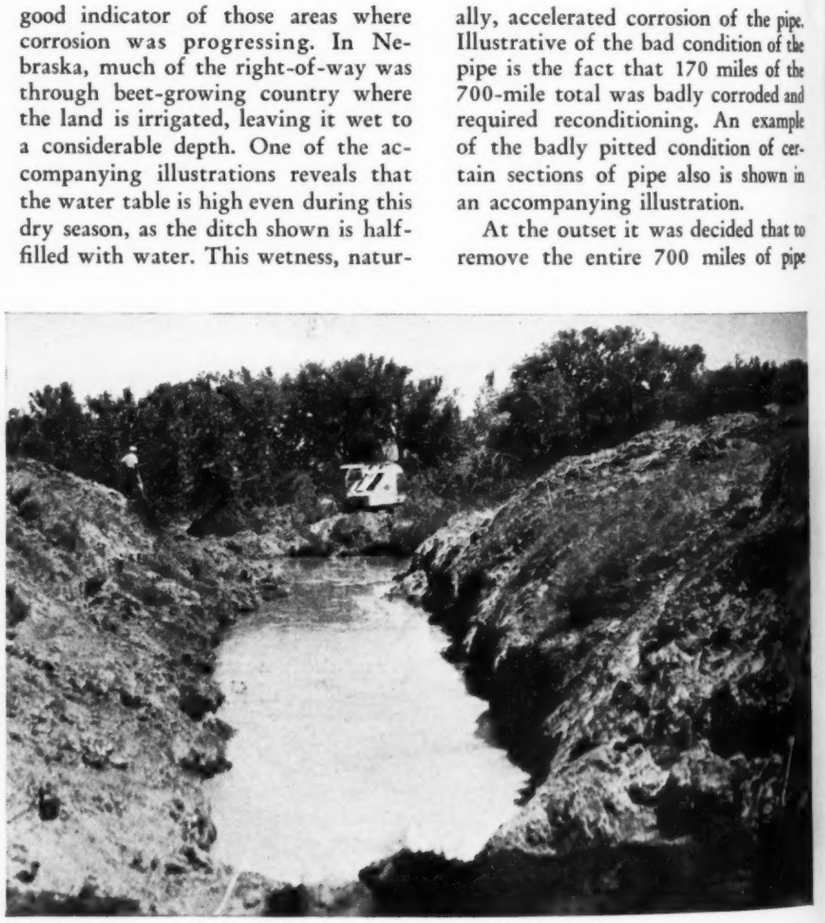
Reconditioning a 700-Mile Pi

Extending the life of a trunk pipe line by the successful application of modern reconditioning methods

A MAJOR reconditioning job has been completed by the Stanolind Pipe Line Company on its 12-in. line from Welch, Wyoming, near Casper, to Freeman, Missouri. This 12-in. pipe line, which is approximately 700 miles long, was originally laid in 1923 as an oil line, but for the past few years has been used for the transmission of natural gas. When it was decided to use the line again for the transportation of crude oil, it was necessary to recondition a large part of it, as the physical condition of the pipe made it unsafe for the handling of the oil. The project was begun the early part of July, 1936, and most of the work completed before the last of 1936, the oil reaching the eastern terminus in December.

The one aspect of the job distinguishing it from similar projects of this nature was the extremely large percentage of pipe found to be badly pitted and corroded and needing reconditioning. Many 20-ft. joints of pipe were found with 14 and 18 holes through the pipe walls. In one section of line, more than 2000 joints of pipe were retaining a single joint that required no spot-welding. The greater part of the corrosion was due to the high percentage of alkali in the soil, but a small percent of it was caused by old collar leaks. None of the corrosion was attributed to electrolysis. Some soil along the route was white with alkali and a very heavy stand of alkali and salt grass was growing. The alkali grass was a good indicator of those areas where corrosion was progressing. In Nebraska, much of the right-of-way was through beet-growing country where the land is irrigated, leaving it wet to a considerable depth. One of the accompanying illustrations reveals that the water table is high even during this dry season, as the ditch shown is half-filled with water. This wetness, naturally, accelerated corrosion of the pipe. Illustrative of the bad condition of the pipe is the fact that 170 miles of the 700-mile total was badly corroded and required reconditioning. An example of the badly pitted condition of certain sections of pipe also is shown in an accompanying illustration.

At the outset it was decided that to remove the entire 700 miles of pipe



Uncovering with dragline an approach to the North Platte River, near Glenrock, Wyoming

Ditch half filled with water, revealing that the water table is high even during a dry season

Pipe Line » » »

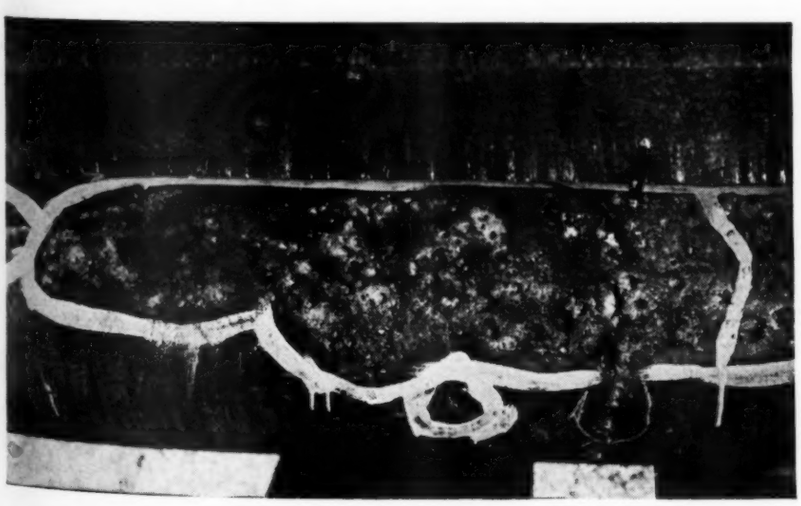
By FRANK H. LOVE

from the ground would be an unnecessary task, as well as a lengthy one. As a consequence, bad sections of pipe were determined from a study of the line's leak records and by visual inspection of areas where corrosion was expected due to surface indications of the ground. When a corroded section of line was located, such pipe was uncovered in both directions and removed from the ditch until a reasonable amount of good pipe was found.

In carrying out its program of reconditioning, the company adopted a practice not used previously on such an extensive scale. When the corroded areas were determined the soil was stripped from the pipe with ditching equipment, the collars torch-cut, one cut being made on the top side of each collar, and the pipe raised from the trench. The pipe, cut into 20-ft. joints, was loaded on to trucks and hauled to a centralized yard. A number of these yards were in operation simultaneously, spaced 15 miles apart, and were operated on a 24-hour a day schedule. Upon arrival at the central yard, the first step in reconditioning was the cleaning of the pipe with a stationary-type cleaning machine. The pipe was then graded and the threads trimmed with beveling machines. The corroded areas were spot-welded and the welds ground smooth with pneumatic grinding wheels. In this manner a smooth surface was procured, avoiding likelihood of puncturing the coating that was later applied and also permitting more ready inspection of the spot welds, and detection of pin holes and other defects. This practice of grinding spot welds has been employed before but never so extensively.

Only a comparatively small percentage of pipe was not salvaged despite the bad condition due to corrosion. A few years ago this would have been an impossibility; such has been the advance in reconditioning methods and equipment. Returned to the line, the 20-ft. joints were electric-welded into sections approximately 200 ft. in length, and these sections in turn were welded into the line. A traveling-type cleaning machine with a priming machine attached was passed over the pipe prior to the application of the coating. The coating, consisting of asphalt and felt, was applied in the following manner: the asphalt to a thickness of 3/32 of an in. was applied to the pipe by a coating machine and asbestos felt wrapped about the pipe spirally while the asphalt was still hot, thus giving a bonded job. Finally another coat of asphalt 1/16 in. in thickness was applied by hand to the outside of the felt. The pipe was handled by cradles attached to the tractors to avoid handling of the coated line. It was lowered into the ditch, except slack loops, at the time it was coated. Final steps were the lowering-in of the slack loops and back-filling.

Many narrow rivers were crossed by the line; however, for the most part, they were of insufficient width to present any difficulty in taking up the pipe and relaying it in these places. One of the wider crossings was the Kansas River near Topeka, Kansas. At the point where the crossing was made, the distance from bank to bank is 1200 feet. The pipe string was weighted with river clamps, each weighing 1000 pounds. A small island in the river made it necessary to dig a trench for the pipe at that point, otherwise it was allowed to come to rest on the river



An extremely large percentage of pipe was found badly pitted and corroded

Another example of the badly pitted condition of certain sections of pipe

bed, the current of the stream serving to cover it with silt and sand.

The longest river approach uncovered and reconditioned was that to the North Platte River near Glenrock, Wyoming, it being 400 ft. in length. Here it was found necessary to dam off one of the branches of the river before the men could get in to work. The soil was porous and of an extremely cavey nature, but this difficulty was overcome by sloping the sides of the trench when uncovering the pipe, a dragline being used for the purpose. Then, too, the pipe originally was laid with a covering of eight to ten ft., and when relaid was covered with but 24 in. of soil. Thus a certain amount of caving did no harm, in fact, was desired.

The enormousness of the project made it necessary to use numerous gangs, widely spread. Three large units and six and seven smaller ones were employed at all times.

KEYS and KEYWAYS

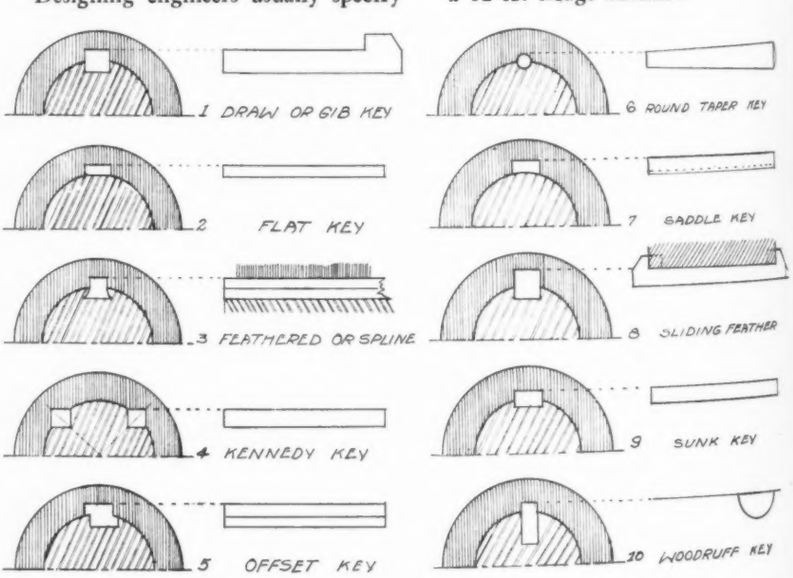
By JOS. L. INGRAM

In ordering or making new keys and keyways for pipe line station equipment much trouble can be avoided by observing certain essentials

WITH the some 15 or more types of keys and keyways employed in machine construction, quite often the machinist or the members of the engine room force become confused when ordering or making new ones. One familiar with machinery knows the trouble experienced extracting a key driven into too small a keyway, or one that was too large and was forced, resulting in too tight a fit. A proper fit cannot be procured by pounding the key flat in spots, and one does not have to be experienced to know what will happen if the key is so loose the wheel comes off. A proper key, and a keyway made to fit it, of course, are essential. The accompanying illustration shows ten of the keys most used.

The strength of the sunk key is the measure of its holding power, which reaches the maximum only when properly fitted in the keyway. In the case of the IXL keyseat, if the strength is its holding power, a key having w as its width, t as its thickness, l as its length, all in inches, a unit shearing strength of f_s, and a crushing resistance of f_c in lb. per sq. in. will have a shearing strength in lb. per sq. in. of f_s wl, and a crushing resistance of f_c ($\frac{1}{2}$ tl).

Designing engineers usually specify the correct key design for the particular job and it is up to the maintenance crew to see that they are kept in good condition. It is suggested that a few moments be taken to look things over before driving a $\frac{3}{8}$-in. key home with a 12-lb. sledge hammer.



Heaters for Crude Oil Emulsions

By WILLIAM WOELFLIN*

Selection of heater having lowest installation and operating cost, and one satisfactory from standpoint of maintenance, important

Fig. 1

WHEN necessary to heat crude oil emulsions before they are dehydrated, it is desirable to select the heater that will have the lowest installation and operating cost, and at the same time be satisfactory from a maintenance standpoint. Frequently, it is possible to obtain sufficient gas from the well to supply the fuel for heating the emulsion; in which case, the operating cost will be relatively small; however, if it is necessary to purchase gas, or to use oil for heat, the operating cost is of considerably more importance. Likewise, the maintenance cost usually is small; although it may reach a relatively high figure because of repairs and frequent wash-out jobs if the proper heater is not selected. It is the purpose of this article to discuss the various types of heaters that are available, and endeavor to point out the advantages and disadvantages of each.

The usual heaters for crude oil emulsions may be classified as follows:

High-pressure steam
Low-pressure steam
Coil-type boiler heaters
Direct-flame boiler heaters
Pipe heaters.

This classification does not include those heaters that use waste heat from gas engines as a source of heat.

High-Pressure Steam Heaters. High pressure steam frequently is used for heating crude oil emulsions prior to dehydration. The steam may be employed either in a closed steam coil in the bottom of a tank, or the emulsion may be heated while being pumped through a heater.

Heating emulsions in tanks is not considered good practice for a number of reasons. The steam may be left on too long and the tank boiled over, resulting in a serious fire hazard. Even where the oil is not boiled, heating in a tank frequently will cause a sufficient amount of the low-boiling petroleum fractions to be evaporated to reduce the gravity of the crude oil one or two deg. A.P.I. The heating of oil by this method is not recommended, except in some instances where the crude oil is heated to drop out sand, or where the emulsion is extremely viscous and it is necessary to apply some heat in the tank to reduce the viscosity sufficiently for the pump to take suction on the oil, or for the oil to flow by gravity through the dehydrating plant.

High-pressure steam heaters, built for a maximum operating pressure of 150 lb. per sq. in. on both the oil and steam sides, have been used to a considerable extent for heating crude oil emulsions. These heaters are small, of compact design, and are very satisfactory whenever there is steam available on the lease. The heaters of this type that are equipped with an electric dehydrator contain 184 tubes of ¾-in. outside diameter and 16 gauge, and contain 80 to 100 sq. ft. of heating surface, depending on the length of the tubes. The oil flows through the tubes, and the steam around the outside of the tubes. The heads are baffled, so these heaters are of the multiple-pass type. A typical installation of a short tube heater is shown in Fig. 1.

The amount of crude oil emulsion that can be heated with a heater of this type will depend on a number of factors, including the temperature differential between the steam and the emulsion, the viscosity and water-content of the emulsion, and the rate of flow through the heater. The data in column 1 of Table 1 show the heating capacity of a heater used for heating crude oil emulsions going to an electric dehydrating plant. The efficiency could not be figured because data on the amount of steam necessary were not available. The heat transfer rate was quite high, being 20,700 B.t.u. per sq. ft. per hour.

These heaters can be used for heating oils containing sediment since they may be easily cleaned by removing the heads and washing out any sediment. In event a hard scale is deposited, it may be necessary to drill the scale out of the tubes. The deposition of sediment in the tubes frequently can be avoided by increasing the velocity through the tubes by increasing the number of passes, and thereby increasing the turbulence to a degree that the sediment cannot be deposited.

There are a number of thermostats on the market that can be installed to maintain automatically the proper temperature at the outlet of the heater. Those controllers operating over a temperature range of plus or minus five deg. fahr., are satisfactory.

Ordinarily it is not economical to

TABLE 1
HEATING EFFICIENCIES OF STEAM AND COIL-TYPE HEATERS

Type Heater	1 Steam H.P.	2 Steam L.P.	3 Coil
Flow rate in bbl. per hr.	123	66.7	70.4
Water in emulsion	12.4%	17.0%	51.7%
Bbl. of oil heated per hr.	108	55.4	34.0
Gravity of oil °API at 60° F.	25°		22.3°
Bbl. of water heated per hr.	15	11.3	36.4
Temperature rise °F.	75°	50°	71.5°
Gas consumption in cu. ft.		1250	1365
B.t.u. per cu. ft. of gas		1000	1150
Efficiency of heater		51.4%	83.0%
Sq. ft. heat transfer surface	80	250	373
Heat transfer B.t.u./sq. ft./hr.	20700	2575	3600

*Petroleum Rectifying Company of California.

heat oil with high-pressure steam, unless the dehydrating plant is situated where steam is necessary for other purposes, and part of it is available for heating the crude oil. Even at these plants, the bulk of the heat can be supplied by the exhaust steam from the engines, and the high-pressure steam used only for make-up purposes.

It has been estimated by operators at Signal Hill, California, that it costs approximately 50 cents an hour to operate a 75-hp. steam boiler. This cost includes fuel, water, repairs, maintenance, and inspection, but not labor. Whenever a boiler is being fired solely to supply high-pressure steam for dehydration, lower costs and automatic control of temperature can be obtained by changing to some of the other types of heaters.

The advantages of high-pressure steam heaters (where a boiler is available to supply steam) are the low first-cost, low installation cost, and low maintenance cost; and the small space required because of the high heat transfer per sq. ft. of heating surface. The disadvantages are the high cost of steam, especially if a boiler is fired to supply the steam necessary for heating a relatively small volume of oil.

Low-Pressure Steam Heaters. There are some low-pressure steam heaters used for heating emulsions prior to dehydration. In most instances these heaters are constructed by the producer after his own design, using boilers, heaters, and equipment already at hand. In general, the low-pressure steam heaters are made from boilers that will no longer stand boiler inspection for high-pressure work, and a heat exchanger that may be available on the lease. Installations of this type are shown in Figs. 2 and 3.

In the plant shown in Fig. 2, the crude oil emulsion feeding the dehydrator is electrically pumped through heat exchanger (1), where the temperature is raised to 130 deg. fahr. by heat from the hot oil. It then travels through several passes of groups of

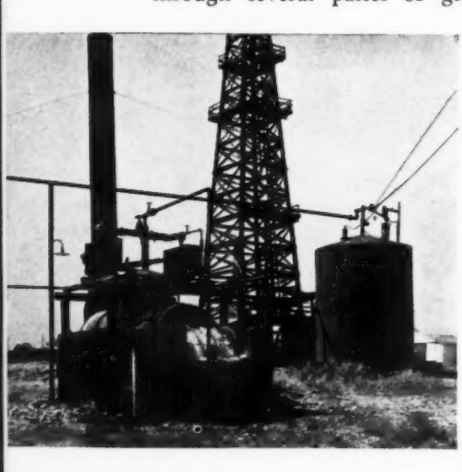


Fig. 3

Fig. 2

¾-in. tubes in the low-pressure steam heater (2), which contains 250 sq. ft. of heat transfer surface. The temperature of the emulsified oil is increased to 180 deg. fahr., and the emulsion is then dehydrated by passing through the electrical dehydrator.

The low-pressure steam is generated at six lb. per sq. in. pressure in the 70-hp. fire box type boiler (3), and travels through the upper portion of the 6-in. line (4) to the heater. The condensate is collected in the lower chamber of the heater and returns by gravity to the boiler by running along the bottom of the 6-in. line (4). A pop valve on the boiler is set at 14 lb. per sq. in., automatically removing the boiler from the high-pressure boiler code. It is therefore not necessary for the boilers to stand state inspection. The boiler is filled with water once, and needs no additional supply except a few gallons occasionally to make up for the water lost by leakage. Data on the heating efficiency of this heater are given in the second column of Table 1. The overall heating efficiency is 51.4 percent, and the heat transfer 2575 B.t.u. per sq. ft. of heating surface per hour.

Fig. 3 shows a low-pressure steam installation, in which the heaters are mounted directly above the boiler. In this instance the steam passes through a 2-in. line and enters the top of the heater. The bottom of the heater is connected directly to the top of the boiler so the condensate drops back into the boiler.

In the low-pressure steam installation where no boiler feed pumps are used, the heater must be higher than the boiler in order that the condensate returns by gravity. Where the heater is not directly over the boiler, both the steam line and condensate return line should slope upward from the boiler, and there should be no loops in the line that can cause a gas lock.

This type of heater is particularly well suited for locations where boiler feed water is expensive, and where it is corrosive and causes rapid deterioration of the boiler and heaters. These heaters readily can be cleaned by removing the heads and washing or drilling out any material that may be deposited in the tubes, and for this reason frequently are used for heating oils that contain sediment. The installation is not expensive, as in most instances a condemned boiler is available for utilization in low-pressure service.

The heater may be of the same kind as that used for heating with high-pressure steam, but must contain more heating surface since the heat transfer per sq. ft. per hour is lower with low-pressure steam. The steam line and condensate return lines also must be larger when heating with low-pressure steam.

The Coil-Type Boiler Heater. The coil-type boiler heater is essentially the same as a low-pressure steam heater in which the heating coil is placed inside the boiler. Heaters of this type may be purchased, or made up by using a discarded steam boiler. The oil-heating elements in these heaters vary considerably in design, depending on the manufacturer or producer that makes up the heater. In any event, the heat transfer is from the hot gases through the metal to the water, and from the water or low-pressure steam in the upper part of the boiler to the oil.

The earliest coil-type boiler heaters were made by welding a pipe coil and immersing it in the upper part of a return tubular boiler. To do this it usually is necessary to cut out about half the tubes in the upper part of the boiler. The oil coil in this type is one continuous coil with the inlet and outlet ends welded into the flue sheet.

The later coil-type heaters usually are the multiple-pass type. The upper half of the tubes in a return tubular boiler are removed, and a new tube sheet welded in place to take the oil tubes, which may be from ¾ in to 1¼ in. in diameter. A baffled head is bolted on at each end of the boiler to cause the oil to make as many passes through the heater as desirable. The back arch is rebuilt below the oil tube head so that the flames will not come in contact with the head. The boiler is equipped with a pop valve so the maximum pressure is limited usually to 15

lb. per sq. inch. It is filled with water when starting up and no additional water is necessary, except a small amount to replace water lost through leaks. A heater of this type is shown in Fig. 4.

Several manufacturers have made heaters of this type following their own designs. They are constructed to operate in the same manner whether they are manufactured from new material or from a discarded boiler, using material on the lease.

The temperature to which the crude oil emulsion is heated can be controlled by a thermostat placed in the oil heater at about the middle pass.

The heating efficiency of the coil type boiler heater usually is high, and efficiencies of 50 to 90 percent have been measured on various installations. Column 3 of Table 1 gives the results of a carefully-made test on a Taylor heater, showing a high efficiency of 83.0 percent.

The coil-type boiler heater is similar to the low-pressure steam type and is applicable to the same conditions; that is, where boiler feed water is expensive or corrosive to the boiler and heaters. These heaters can be cleaned readily by removing the heads and cleaning the oil tubes, and frequently are used with oil that contains sediment that may cause an incrustation inside the tubes. If the tubes are plugged with sand and shale that settles out of the oil during the heating period, they frequently can be kept clean by increasing the velocity through the tubes so that the oil is in extreme turbulent motion.

Automatic Temperature Control. The automatic control of temperature when heating crude oil emulsions is desirable with all types of heaters. When the heater is on the flow line of a well, automatic control is necessary to change the amount of heat when a well heads, and to shut off the fire in case a well quits producing because of failure of equipment, such as parted rods, or failure of pumping engine.

Where the emulsified crude oil is pumped through the heater continuously at a constant rate, the automatic control of temperature is not essential; however, automatic control even in this instance will decrease the amount of plant supervision necessary, and will increase dehydration efficiency because there will be less fluctuation in the temperature of dehydration, particularly the fluctuation due to the difference in the temperature of the air during the day and at night.

When a thermostat is installed to control the temperature, it should be placed in the emulsified crude oil that is being heated rather than in the outflow line from the heater. If the thermostat is in the outflow line the oil will cool by radiation from the pipe in case the flow stops, and open the gas line or steam line to the heater, resulting in overheating the oil.

Thermostats for high-pressure steam heaters usually are placed in the outflow line, since these heaters are of such compact design that there is not sufficient room to place the thermostat in the heater head. It should be placed as close to the heater, however, as possible.

In the case of a low-pressure steam, or coil-type heater, it frequently is possible to install the thermostat in the head at about the middle pass. Another method of temperature control that is sometimes applied to these heaters is a pressure regulator to maintain the pressure in the steam space at a definite pressure found by experience to be necessary to maintain the oil at the proper temperature. The temperature of steam at the relatively low pressure of two to ten lb. per sq. in. is not high enough to build up excessive pressure in the oil side of the coil, or to overheat the oil, in event the flow stops. Since the temperature in the oil coil is regulated by changing the temperature of the large volume of water in the boiler, the control of the oil temperature is rather sluggish, which makes this type of heater most suitable to those plants where the flow of oil is constant.

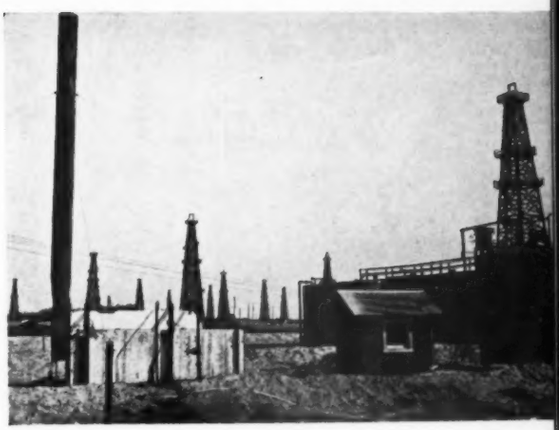


Fig. 4

Heater Efficiency. Efficiencies obtained with low-pressure and coil-type heaters are given in Table 1, together with the heat-transfer data on a high-pressure steam heater.

These data refer to specific plants and cannot be considered as average values for the various types. The coil-type heater should be more efficient, however, than the low-pressure steam heater, since there is less surface for radiation to the surrounding air due to the heating coil being immersed in the fluid inside the boiler.

Self-Contained Portable Steam Power Plant

A SELF-CONTAINED portable steam power plant, known as a Steamotive unit, has been designed to have the following characteristics: good efficiency, simple operation, small space, simple and inexpensive foundations, suitability for marine or land propulsion, adaptability to a variety of fuels and ability to respond rapidly to variations in load. A forced circulation boiler supplies steam at 1200-lb. pressure and 950 deg. fahr. temperature to a specially-designed turbine generator. These elements are unified by completely coördinated auxiliaries and automatic control, says John Liston, of the General Electric Company, in his annual review of the electrical industry.

A complete power plant of this type, using one oil-fired boiler unit with a condensing extraction turbine-generator was built for industrial use, and is now being installed in a small isolated manufacturing plant for supplying electric power and low-pressure steam for building heating. This Steamotive unit has an electrical capacity of 750 kw., the steam being supplied to the turbine at 1200 lb. per sq. in., and 950 deg. fahrenheit.

In addition, a boiler unit only was built and is now operating commercially to supply high-pressure steam for testing purposes. It is oil-fired, and designed for an output of 21,000 lb. of steam per hour, at a pressure of 1500 lb. and a temperature of 900 deg. fahr., leaving the superheater.

The auxiliaries, geared together as one turbine-driven unit, consist of a boiler-feed pump that delivers 25,000 lb. of water per hr. at a pressure of 2000 lb.; a blower for 30,000 lb. of air per hr. at 60 in. water pressure; a fuel-oil pump; and a lubricating-oil pump.

The meters and complete automatic control coördinate the auxiliaries and the supply of fuel, air, and feedwater to control steam output, pressure, and temperature, together with complete automatic ignition and safety equipment.

Pipe Line Reconditioning Practice

A definite method of procedure has been adopted by Standard Oil Company of California for all its lines, which, over a period of years, has been found to give satisfactory results

By J. C. ALBRIGHT

STANDARD Oil Company of California, with its network of gathering and trunk oil lines interlaced throughout Southern California, especially within the Los Angeles Basin where there are numerous active oil fields, finds that, after many years, electrolysis and adverse soil conditions have caused much surface pitting of pipe. These corrosive areas usually are found in sections where the surface of the ground is considerably lower than the surrounding terrain, aggravated by irrigation water and exceptionally heavy rainfall. Often the ditch in which several lines are buried parallels state and county highways, with the "borrow pits" standing full of water throughout the winter months. Dairies, many of which are along the right-of-way of the line, cause the soil to remain damp, due to the loose mulch in the corrals where cattle are fed.

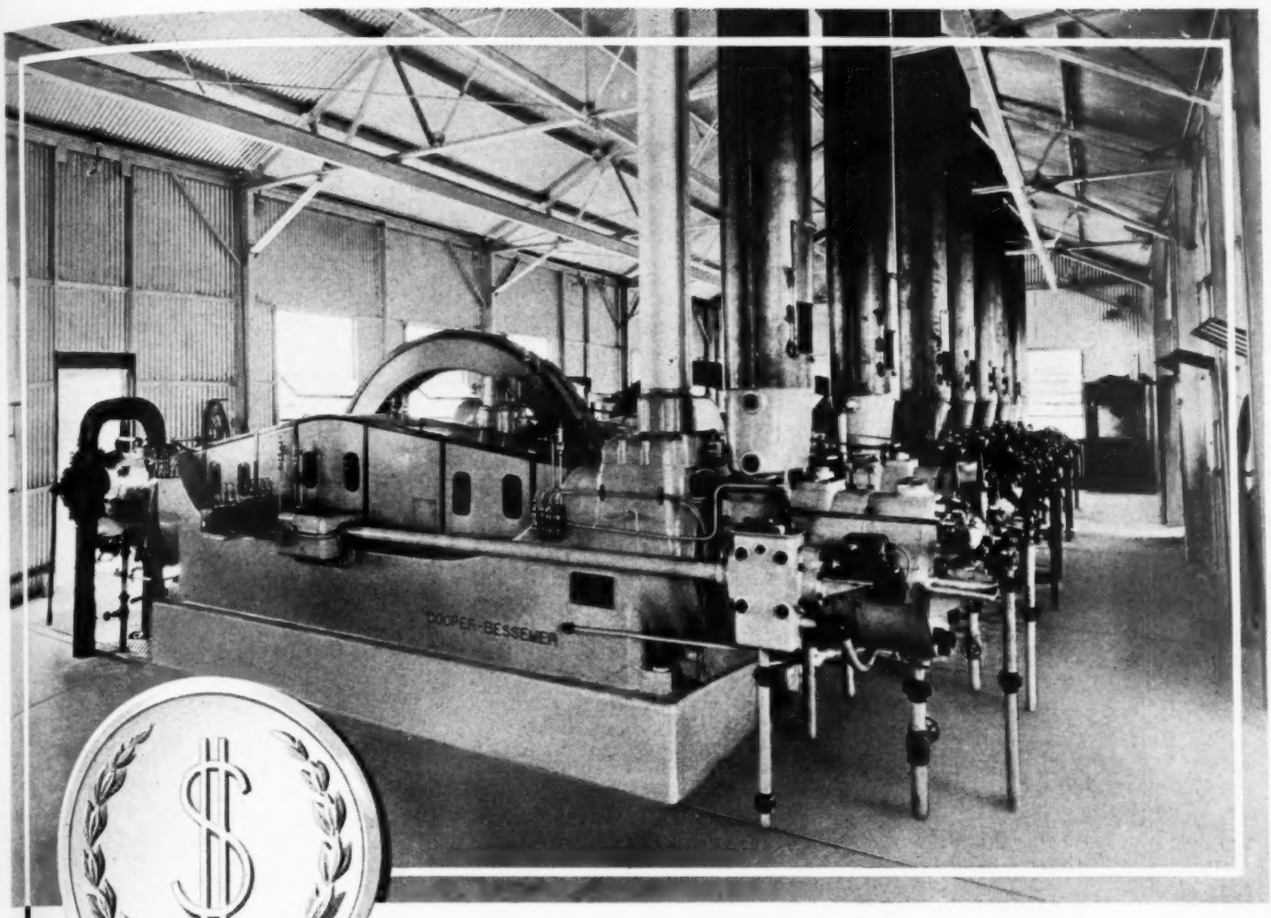
A definite program is followed by this company when reconditioning pipe lines laid in these areas. The first step calls for an inspection of the line, or lines, by electrical measurements, when such facilities are available, or by digging bell holes at intervals to uncover small sections of each line for inspection of the surface of the pipe. If the pits uncovered show that deterioration has progressed to a degree that leaks may develop within a short time, the entire section is stripped of cover, exposing all the lines in one wide ditch.

When performing the greater number of these repair jobs, tractor-operated ditching shovels are employed to speed up the removal of the bulk of the backfill. Removal of the loose soil and that alongside the pipe is done with men using picks and shovels, to prevent damage to the lines and in order that they may be exposed to inspection with as much surface showing as possible. Winches used to raise the pipe are those ordinarily employed in pipe line work, constructed with four supporting legs to straddle either the ditch, if a narrow one, or the pipe to be lifted. Wooden blocks are placed beneath the lines after they have been raised free of the supporting soil so that a full inspection of the entire surface may be made, and also in order that each joint may be rotated when necessary.

Below—After being scraped by hand, the pipe lines are ready for the sand-blasting machines

Above—Pipe lines being uncovered by Standard Oil Company in the Hynes-Clearwater district of Southern California to be reconditioned without removal from the ditch

Reconditioning jobs are carried out in an orderly and progressive manner



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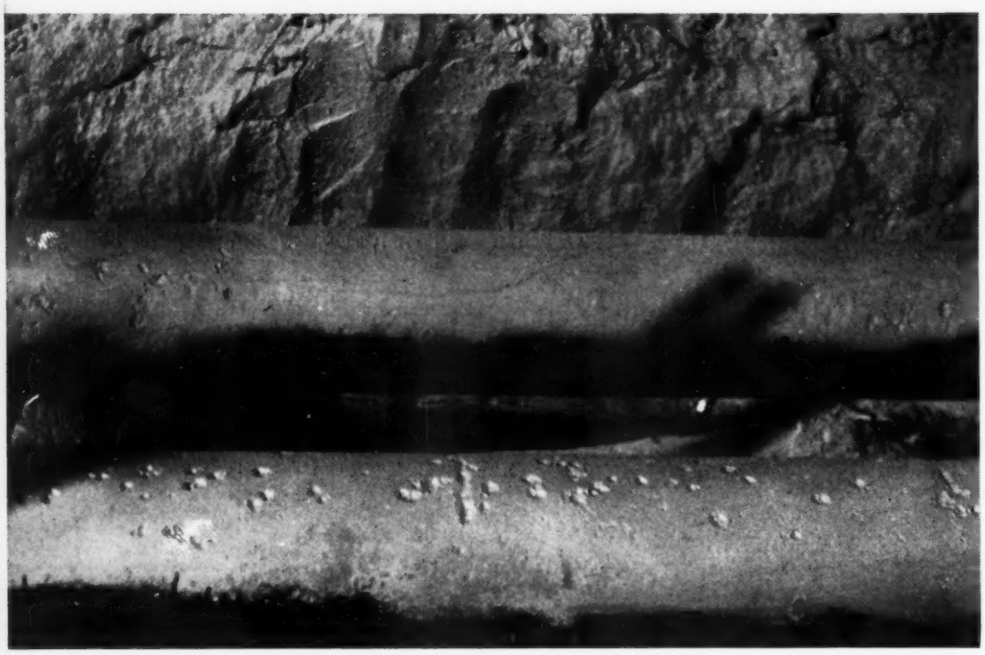
The lines being cleaned by blasting the surface with El Segundo dune sand



Pipe lines after being cleaned of all surface covering, showing pits of varying degree of penetration

with the tractor shovel leading the way, followed by the workmen using hand-ditching tools. The repair gang is divided into several units. The shovel removes the bulk of the soil, then follow shovel men, pipe scrapers, sand-blast operators, inspectors, and welders; finally the gang applying the primer and coating, and then backfilling completing the job. The scrapers used to remove the harder parts of the soil sticking to the pipe, as well as the original bituminous covering, provided any had been applied when the pipe was laid, are fashioned from pieces of automobile spring, kept sharp with carborundum stones attached to the side of the tool car. In most instances the material adhering to the pipe lines breaks away easily. Some of the coating removed from lines was applied 15 and 18 years ago, but the pipe has pitted beneath it, said to have been caused by blistering and cracking of the protective covering.

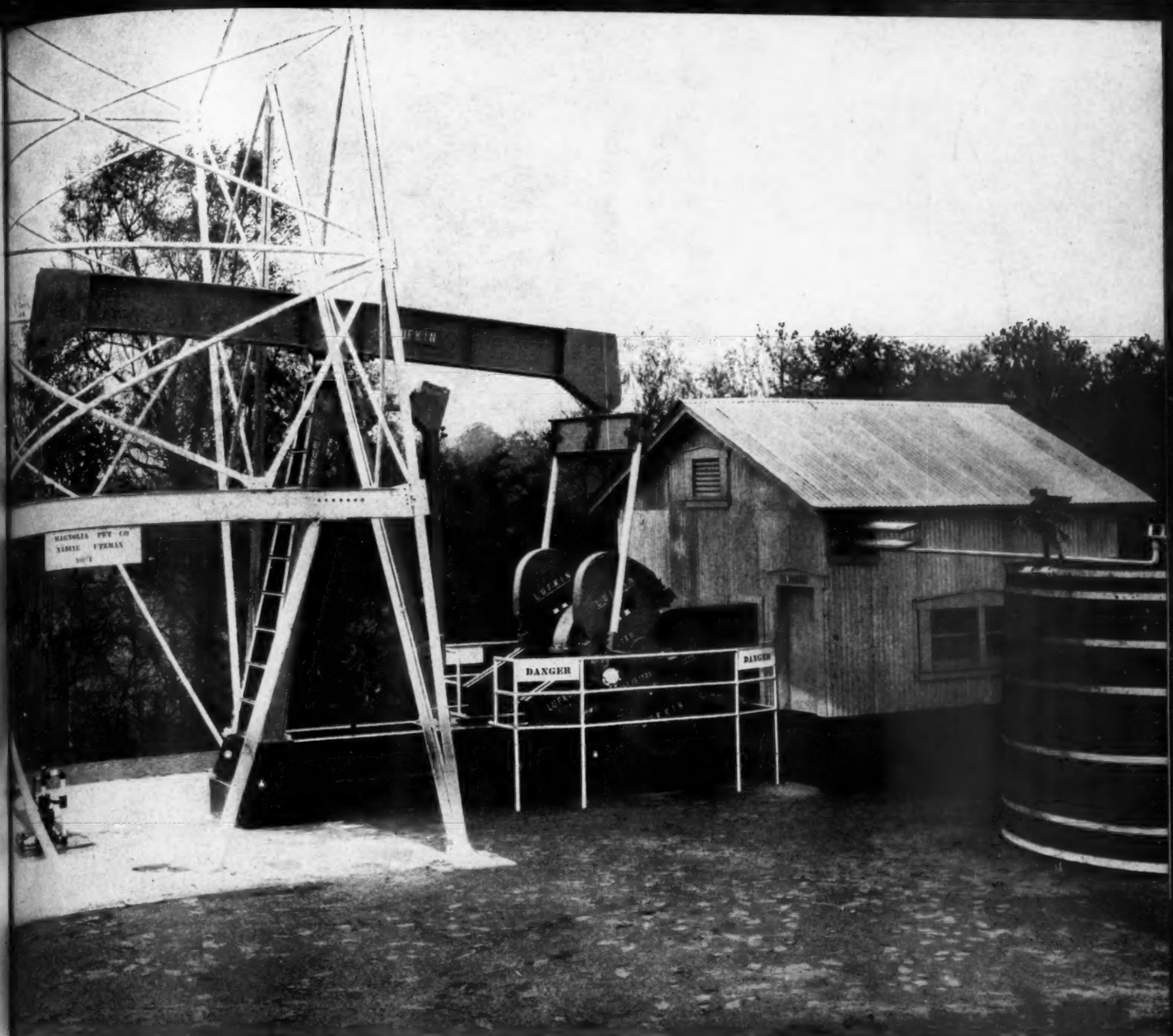
While the pipe is being prepared for reconditioning, operators of the sand-blasting machines work behind the crew using the hand scrapers, completely removing all remaining bituminous coating, scale, and oxidized metal. The sand-blast operators watch the results of their work through head masks, and after they have passed over a joint the surface of the pipe shows a dull gray.

It has been found that a very desirable sand for this type of work may be obtained from the dunes on the coast west of El Segundo where the Standard Oil Company has a large refinery. Sand is collected from the surface of the ground, preferably when the weather has been dry for a considerable length of time, in order to avoid a large amount of natural moisture. It is screened to remove vegetable matter and larger particles that may be present, these being in quite small volume, however. The type of sand obtained from the dunes is consistently of a mesh suitable for use in the blasting machines; its grains, while not large, have a sharp edge that cuts well, and being obtainable in abundant quantity the cost is nominal.

The procedure followed by men in the field is such that several joints of pipe are sand-blasted in a continuous operation, first cleaning only the upper half. Inspectors follow who measure the pits and mark with chalk those requiring filling so that the welders may follow through with little waste of time. Most of the pits uncovered are found to have penetrated only the outer surface of the pipe, while in other instances but a small thickness of metal remains. Scattered pits are sufficiently deep and large that occasionally patching is required.

After the several joints previously sand-blasted have been reconditioned by spot-welding or patching, the primer coat is brushed on by hand before the pipe has had an opportunity to oxidize. Other crews then rotate the pipe so that the lower surface may be cleaned and repaired in the same manner. Backup tongs are placed on the collar behind the excavated lines and on the one ahead of the joint being rotated, only a half turn being required to move the pipe. The next joint is handled in the same manner until the last one is completed, with only a half thread being backed out of the last collar. The pipe line remains in service throughout the reconditioning, and should a leak appear as a result of moving the pipe in the collars, it can be stopped by flowing a bead completely around the joint at edge of the collar.

After the line has been spot-welded, patched, and primed, it is then wrapped with a bituminous paper. When the condition of the pipe indicates that a strong current has been flowing along the line, ground wires are attached at intervals so that it may be dissipated into the surrounding soil. Test wires are attached to lines leading to con-



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venient telephone poles, so that future inspection may be easily made.

The cost of reconditioning varies somewhat, depending upon the number of lines in the ditch, and the condition of the pipe surface. It has been estimated that where several lines are in the same ditch, as illustrated in accompanying photographs taken a few miles east of Clearwater, the cost is approximately 85 cents per lineal foot of individual pipe, making the cost in this instance $2.55 per lineal foot of ditch, there being two 8-in. lines and one 10-in. line that required reconditioning. The cost includes uncovering, scraping, sand-blasting, priming, wrapping, and backfilling. The fourth line shown in the photographs was reconditioned a few years prior to the other three, and was not disturbed when this latter job was done.

Standard Oil Company has been following this type of pipe line reconditioning for several years, and upon recent inspection those lines first reconditioned have been found in good condition, the pitting having been arrested to a degree that many years of service are expected before the lines will require replacement.

A pipe line after being given a coat of primer, but before wrapping. Note patch welded on upper side of line to cover an exceptionally bad area.

Use of Nickel in the Petroleum Industry

THE petroleum industry offers one of the broadest fields for demonstrating the usefulness of nickel in modern industrial processes, and the growing variety and volume of nickel alloy applications are indicative of the metal's acceptance by this industry, says Robert C. Stanley, president, The International Nickel Company, in his annual year-end statement.

Wide variations occur in the corrosive conditions of the oil industry. Refining processes are working towards lower temperatures for the dewaxing of lubricating oils and higher pressures for the cracking of gasoline. Distillates and other by-products are recovered and processed under varying degrees of corrosion. In seaboard refineries the necessity for using brackish waters presents additional problems of corrosion.

Thus the choice of materials for the vital parts of equipment varies with the operating conditions present in each individual situation.

An outstanding use for nickel steels in the oil industry is in sucker rods.

Low alloy content steels containing nickel, in tests carried out in the oil industry, developed a high resistance to corrosion fatigue in oxygen-free oil well waters containing hydrogen sulphide. As a result they are being studied in further detail for sucker rods, drill collars, and other important parts of oil field equipment.

K Monel is being used for valves and pumps in the petroleum industry, where hardness is a requisite.

The use of nickel steels containing from 2½ to 3½ percent of nickel for the construction of pressure vessels and auxiliary equipment employed in low temperature dewaxing operations of oils has continued and may be considered standard material. These steels have responded satisfactorily to the usual fabrication operations involving welding and, so far as known, have performed well in service.

On the whole, the oil industry is familiar with nickel-alloy steels and uses them extensively. Tool joints and drilling tools and machinery constitute a major outlet for nickel steels in this field. In addition, with the introduction of chemical methods for controlling drilling mud, considerable attention is being centered on the effect of corrosion fatigue upon the useful life of tool joints and drill pipe.

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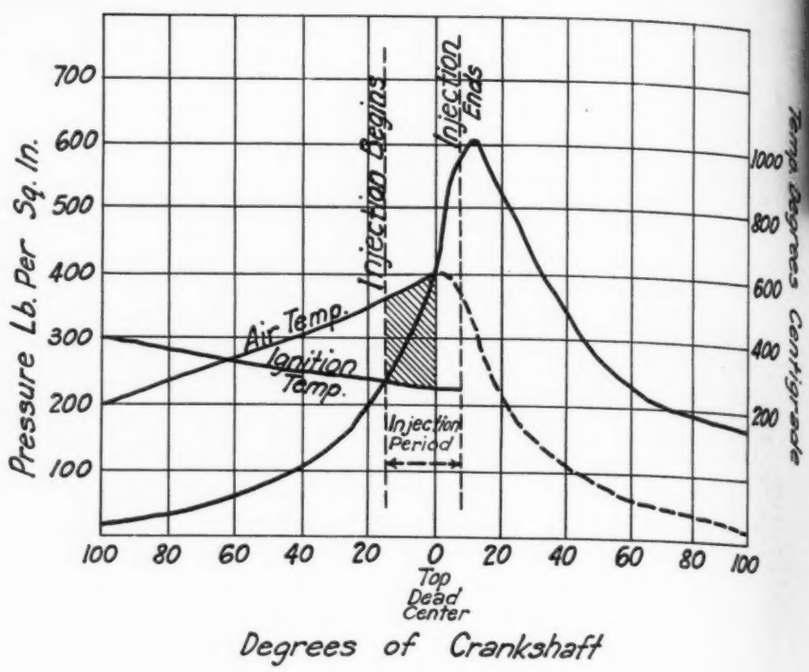
Fig. 1. Graph showing temperature and pressure during injection process



The mechanism of practical fuel systems and how the fuel is prepared for combustion

Diesel Fuel Injection Systems and the Combustion Process

By ORVILLE ADAMS

HAVING previously outlined the principal methods of fuel injection and how the fuel was mixed with the air in the combustion chamber[1], a study now will be made of the combustion process and how it is brought about by means of the fuel pump and spray nozzle acting together as a unit, delivering the fuel from the supply tank directly into the engine cylinder.

It has been shown how the fuel is thoroughly atomized and projected into the compressed air charge, which has attained a temperature above that of the fuel's ignition point, where it is ignited and burned according to the Diesel principle. At the beginning of injection each gobule of fuel at once absorbs heat from the surrounding air. These minute particles of fuel, traveling through the compressed air charge, begin to vaporize as soon as the boiling point is reached. When the compression temperature is sufficiently above the ignition point the fuel vapors thus formed will ignite immediately and the fuel burn uniformly from the surface of the droplets. Should the compression temperature be too low for instantaneous ignition of the fuel vapor, the fuel will continue to accumulate until ignition eventually occurs. A diagram of pressures and temperatures during the injection process is shown in Fig. 1. When the vapor mixes with the air under the latter-mentioned conditions and forms a combustible mixture, it will burn at a greater rate when it eventually ignites than if the ignition began sooner. In this event, there is also a strong tendency for combustion to occur spontaneously throughout the whole of the fuel charge, with the result that the pressure rise will be quite rapid. When this pressure rise is excessive, a very definite detonation occurs, called "Diesel knock". This matter has received a great deal of study during the design and development of the Diesel engine. Actual indicator cards have been studied by such well-known designers as Ricardo, who suggested the explanation of the combustion process that now is generally accepted in principle. He defined the process as consisting of the following three definite stages during the period of fuel injection, as illustrated in Fig. 2.

First: An initial delay period, known as "ignition lag," during which the fuel is injected, but during which no ignition occurs. The length of this period is extremely important, and the shorter it can be made the more satisfactory is the engine operation. Ignition first begins as soon as some minute portions of the injected fuel are vaporized and mixed with sufficient oxygen to form a combustible mixture. It is supposed that the flame spreads from these nuclear points in a manner similar to that in the spark-ignition engine. The delay period is explained as being constant in terms of time rather than degree of crank angle, but much depends upon the chemical nature of the fuel, the pressure of the highly-compressed air, and the degree of atomization of the fuel. Temperatures and injection pressures and the degree of turbulence attained by the air charge during the injection period has a marked influence on the ignition lag. The fuel should begin to burn as soon as it arrives, and though this is almost impossible, the

[1] "Fuel Injection and Combustion Systems in Diesel Engines," by Orville Adams, *The Petroleum Engineer*, December, 1936.

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ignition lag has been shortened by the various means.

Second Phase: This is a period of rapid combustion that results from the mechanical spread of the flame to the main area of the combustion space. Very much like the condition in the gasoline engine, the rate of flame spread, and consequently the rate of pressure rise, is dependent upon turbulence. This rate of pressure rise is constant in terms of crank angle rather than time. This phase of combustion can be modified considerably by turbulence, and in this respect differs significantly from the gasoline engine, for in the gasoline engine all fuel is in the combustion chamber already mixed with the air, whereas in the Diesel engine only a portion so far has been injected and prepared for ignition. It is for this reason that the pressure, although its rate of rise is of the same order as that of the gas engine, with similar turbulence, does not attain anything like the same maximum it would were sufficient fuel present in the combustion space to combine with all the oxygen. For this reason, maximum combustion pressures in the Diesel engine should be relatively lower than in the gasoline engine, and it can now be understood that the pressure rise reached at the end of this "second phase" of the combustion process depends upon the duration of the delay period, which is influenced by engine speed, the rate of injection of fuel, and finally upon both the temperature and pressure of the highly-compressed air.

Third phase: This phase consists of a period during which the remaining fuel is injected and burns as it enters the combustion chamber already containing burning gases at high temperature. As soon as this occurs the flame spreads throughout the combustion chamber and the ensuing increase in pressure and temperature is so great that the rate of combustion is accelerated sufficiently to burn the fuel as it leaves the injection nozzle with practically no ignition lag. A further rise in pressure then occurs, or conditions are sufficient to maintain a *constant pressure* during the remainder of the injection and combustion period. It is seen that this last phase of burning is, or should be, under direct control of the mechanical operation of the fuel system. These three stages or phases, shown in Fig. 2, are marked off on the curve, the dotted line corresponding to the expansion line when no fuel is injected. According to the law of perfect gases, assuming no heat losses to the cylinder walls, this curve would be a looking-glass reproduction of the compression curve.

Elements of Fuel Injection

The fuel pump and spray nozzle must perform the important functions involved in the process of injection. It replaces the carburetor in the gasoline engine. It is evident also that the operation of the fuel pump takes place within a few thousandths of a second. During this very brief interval of time, the pump must build up a pressure of several thousands of lb. per sq. in., discharge fuel over several degrees of the crank angle, return to a state of rest, and be ready to make the next stroke. Under a pressure of from 1500 to 10,000 lb. per sq. in., accurately controlled and measured quantities of fuel, so small that practically no leakage is permissable, must be delivered in such a short interval of time that a few degrees of variation at the beginning of injection and cut-off will affect seriously the operation of the engine.

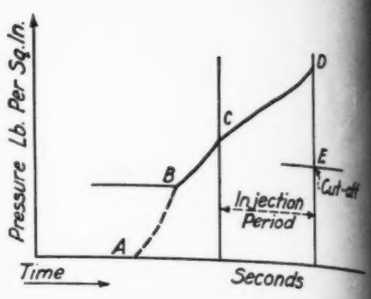


Fig. 3. Pressure-time diagram for jerk pump system

(A) Suction valve or port closes, pressure begins to rise. (B) Pressure rises to valve opening pressure, and at (C), injection begins when atomizer needle lifts, and pressure rises until, at (D), injection ends and valve cut-off operates; immediately (E) pressure falls to cut-off pressure, or approximately valve-closing pressure

As shown in Fig. 3, the pressure rises from zero to that required for proper penetration and atomization of the fuel at an extremely rapid rate, and falls back or cuts off quickly enough to prevent drip. It is evident that the requirements imposed upon the fuel injection pump makes it necessary that this mechanical device be constructed accurately, sturdily, and according to high standards of precision. The fuel-injection pump is a volume-changing device, designed to perform two important functions: measuring the fuel, and delivering it to the cylinder under high pressure. It is obvious that these two functions of the fuel injection pump are possible only if it has the following characteristics of design and operation:

The fuel injection unit, comprising the pump and spray nozzle, must be able to introduce fuel into the combustion chamber in a finely divided or atomized state, suitable for rapid burning and easy ignition. It must spread the atomized fuel into the combustion chamber in such a manner that it will mix intimately with the air for combustion. A careful distinction should be made here between a thoroughly vaporized mixture and an atomized mixture. The fuel mixture of the gaso-

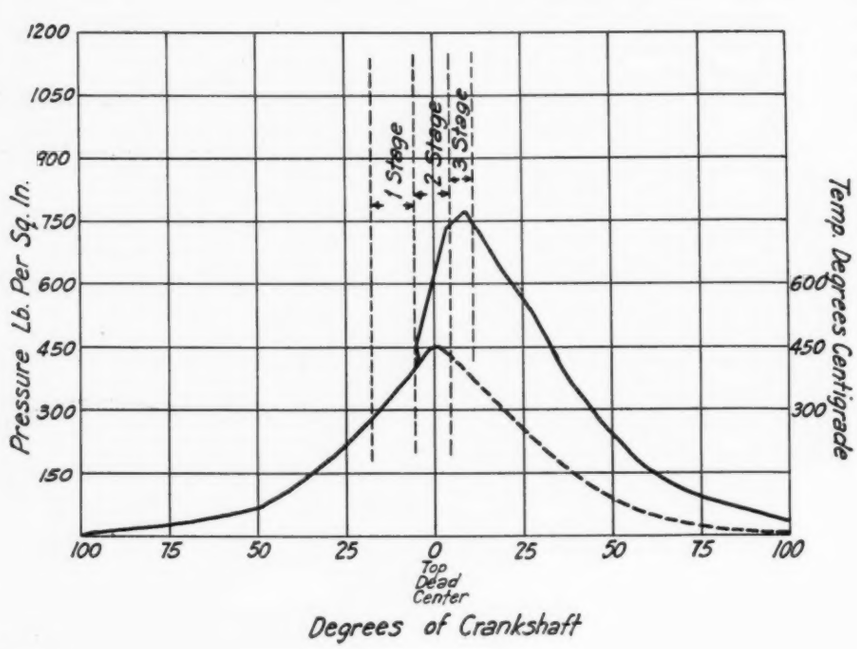
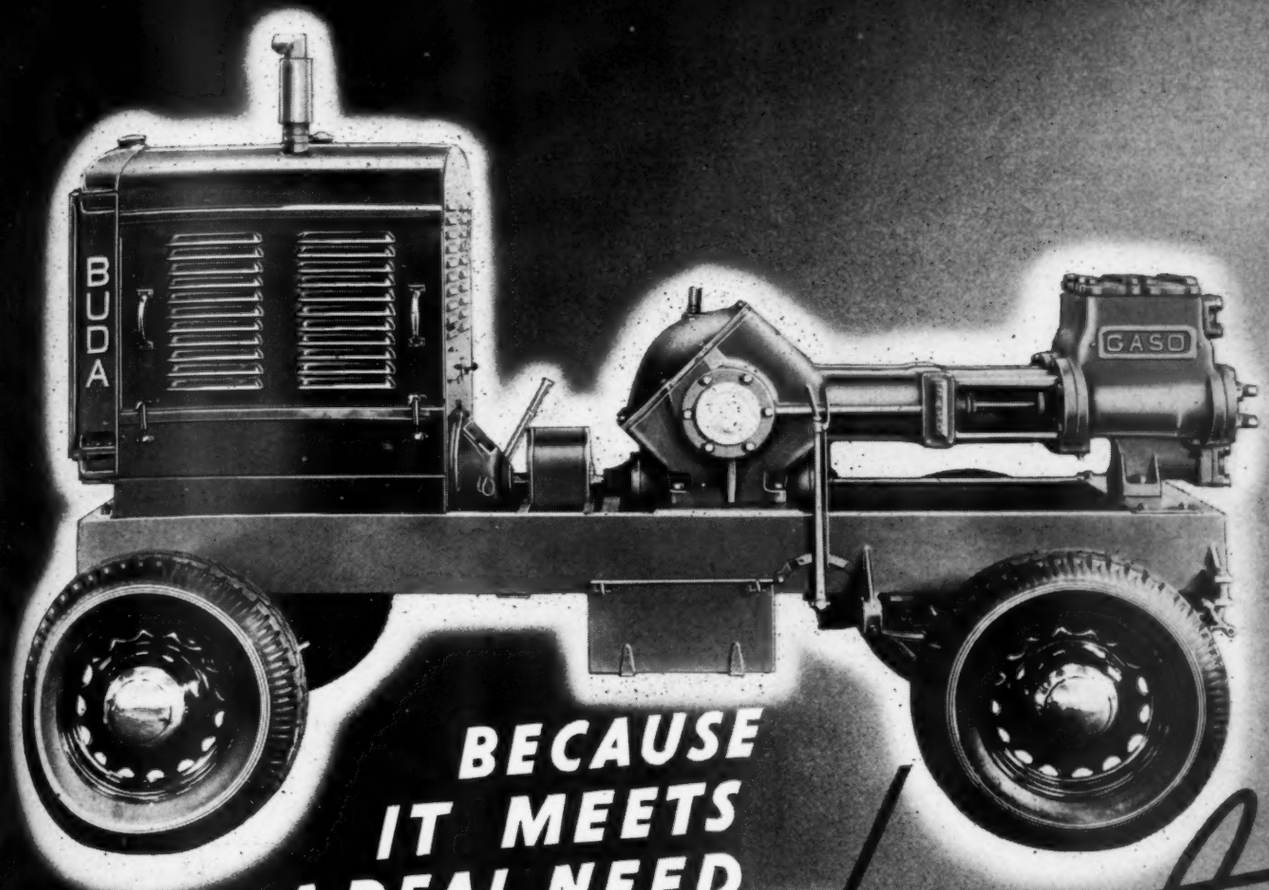


Fig. 2. Three stages of combustion. (Ricardo)



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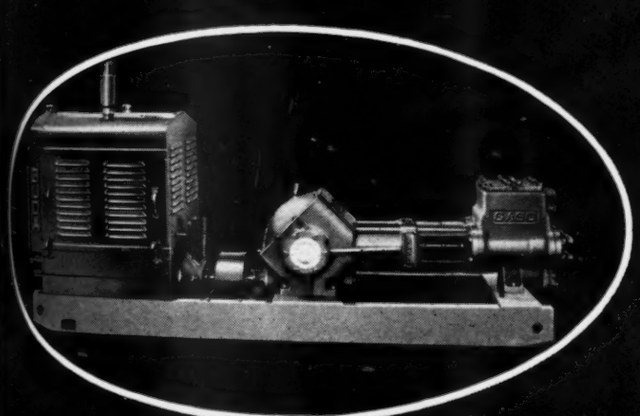

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line engine is a complete vapor, the gas has changed from a liquid to a gaseous state. This is not the case with the Diesel fuel charge. The Diesel fuel is atomized into finely divided droplets, or gobules, still in the liquid state. These droplets begin to vaporize and ignite from the surface. It is not desirable to convert a Diesel fuel charge into a vapor, for this would be contrary to the principle of Diesel combustion as it is now understood, although it frequently is asserted that vaporization is complete in certain designs of engines. It is well known that if the Diesel fuel is converted to a gaseous state, its ignition would be more difficult to accomplish, and that the temperature of the compressed air would need to be higher, and require extremely high compression pressures.

The fuel injection unit must be capable of controlling both the timing and the rate of admission of the fuel so that no undesirable peak pressures will be produced during the combustion period.

The two principal methods of fuel injection now used on Diesel engines are known as the "jerk pump" system and the "common rail," or timed valve, or the "storage system." The jerk pump system introduces the fuel through a spring-loaded automatic injection valve or nozzle by means of an individual pump for each cylinder. This system is sometimes called the "timed pump," as opposed to the timed valve of the "common rail" systems.

Since the jerk pump system is more generally used, this system will be described more in detail. The timing is effected by the pump, which delivers the fuel to the injection nozzle only during the injection period. In Fig. 4 is shown the essential features of design of the modern jerk pump. It is operated by an engine-driven cam, the setting of which controls the timing and the metering, or measuring, of the fuel. The differential needle atomizer, or injection nozzle as it is commonly called, (shown at the right in Fig. 4) definitely controls the beginning and the end of injection by means of its spring-loaded needle. It is hydraulically operated; that is, by means of the pressure built up by the pump. The parts of the pump are indicated.

As shown in the pressure-time diagram in Fig. 3, the ideal pressure requirements for the jerk pump system are low initial rate of injection with an increasing rate until the maximum is reached at the time injection ceases. The ideal pressure-time diagram is a close approximation of that obtained by an indicator. The pressure in the pump working barrel begins to rise upon the sealing of the suction valve or the closing of a suction port at A. At B the pressure in the pump chamber has risen to equal that of the fuel remaining in the delivery line from the last cycle of the pump, the delivery valve then lifting off its seat. This pressure then begins to rise further until the atomizer valve lifts at C, where injection begins. The pressure then continues to rise to point D, when the cut-off valve operates to relieve the pressure that declines to a value lower than the closing pressure of the spring in the injection nozzle, thus giving a sharp cut-off of the injection. There are many variations of this system, the principal divisions being shown in Table 1. An advantage of the jerk pump system is that the method of distribution renders it less difficult to supply the correct volume of fuel to each cylinder, although the speed of the pump is greater than when the common rail system is employed.

Comparing the two main subdivisions of the jerk pump system, as shown in Table 1, that utilizing the entire stroke of the plunger of the fuel pump is open to certain objections that do not exist when only a portion of the stroke of the plunger is used. In the first instance, the plunger must start and stop at the beginning and end, respectively, of its stroke; the in-

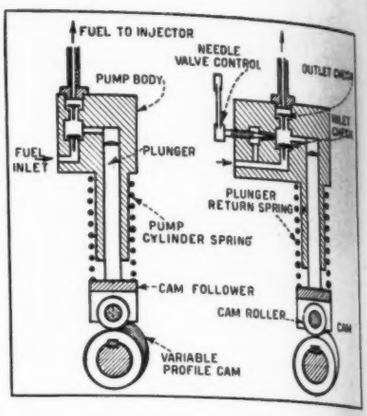

Fig. 5. Two methods of regulating fuel delivery from a pump. That at the left in the illustration has a variable profile cam that varies the plunger stroke. The pump shown at the right is provided with a needle valve that permits regulation of by-pass and therefore provides for changing the net delivery

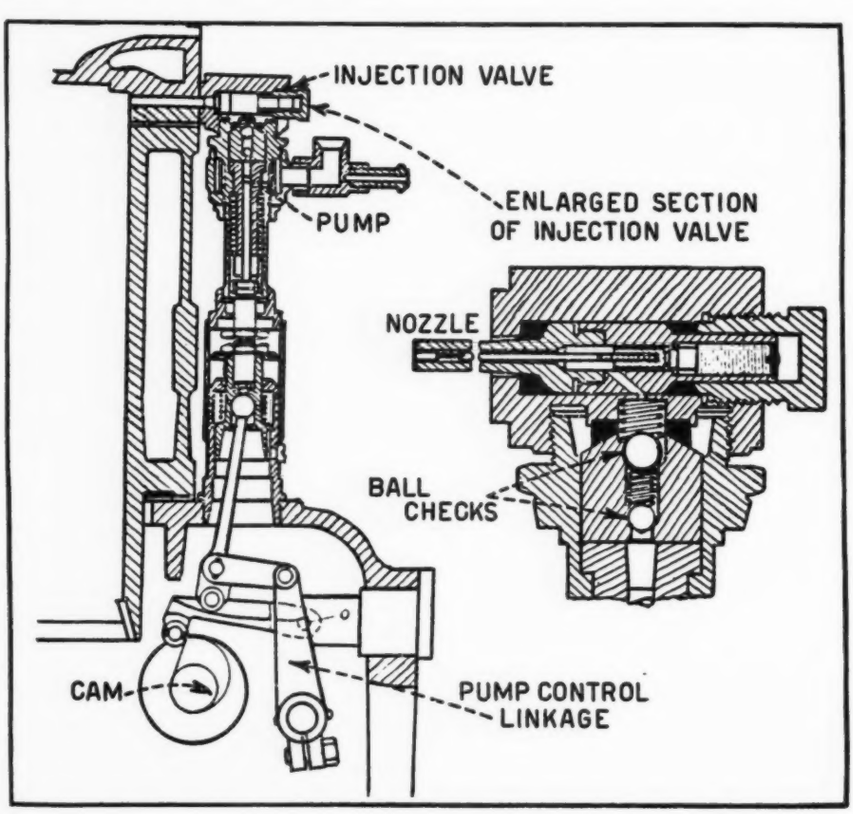

Fig. 4. The Dorner fuel pump shown at the left in the illustration is a variable-stroke pump with constant throw cam. The enlarged construction drawing at the right shows details of injection valve

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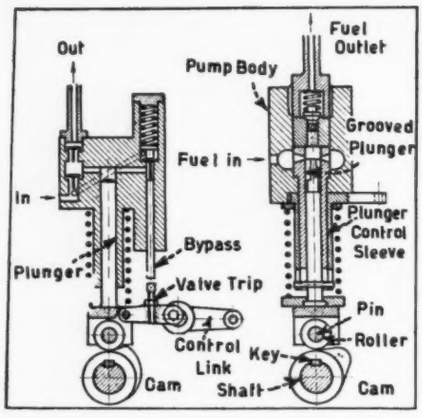

Fig. 6. More methods of regulating fuel pump delivery. These pumps have by-pass regulation. That shown at the left in the illustration has a valve that can be tripped at any desired point in the plunger stroke. The design shown at the right has a sloping groove in the plunger

itial and final deliveries must be relatively slow. This slow final delivery usually is a drawback on high-speed engines, for it is most essential to have a quick cut-off in order to produce rapid combustion with low peak pressures; and the nozzle should not dribble, which it does with slow cut-off.

A well-known fuel pump is provided with a variable amount of lift by altering mechanically the clearance between the plunger and its operating cam. In this instance the suction and delivery valves are both automatic, and the pump is known as the "variable stroke pump." There is a disadvantage to this method, however, in that the load is decreased by reducing the lift of the plunger, which retards the timing of the injection to a certain extent, whereas it is an advantage actually to advance the timing under light loads; however, in one fuel pump of well-known design, an automatic control to advance or retard the cam on its shaft for light- and full-load conditions has been developed. When only part of the stroke of the pump is used for injection, the disadvantage of the full-stroke method is avoided. In other instances pumps cut off at the stop end only; such a type of cut-off is suitable for medium-speed engines. For high-speed work it is desirable that both ends of the stroke be cut off, the central portion only being used. In this instance the plunger has a fairly uniform motion over as much as possible of its stroke, the start of injection being controlled by closing the pump port; the end of the injection is controlled by opening a control port in the pump barrel. With this type of control, a piston valve is used that overruns a port cut in the pump cylinder, or a guide. This piston valve may be either the plunger itself, or a separate piston valve. The port usually is in the form of a round hole drilled in the guide. When the pump valves are thus controlled they usually are operated from the camshaft by means of a rocking lever. An essential feature of the mechanism is that it must be kept absolutely rigid, otherwise there will be a variation in the timing and metering of the fuel to the nozzle.

It is seen, therefore, that the fundamental consideration in the design of the pump is the means employed for controlling the quantity of the fuel and timing its injection. There are two methods of doing this, as shown in Fig. 5.

In one of these, two different means are employed:

By a sliding cam that varies the lift of the plunger, shortening its stroke. The cam has a suitably varied outline.

By needle regulation. Part of the fuel entrapped in the pump during the working stroke of the plunger is permitted to escape through a by-pass to the fuel intake of the pump. The quantity by-passed and, therefore, also the amount of fuel permitted to reach the nozzle, is regulated by means of a throttling pin or needle.

The other method is to have a by-pass port open after the plunger has traveled a definite distance, the port being in connection with the fuel-intake line. In practice this is done by opening a special by-pass valve or the inlet valve of the pump, for a longer or shorter period before the end of the working stroke of the plunger, as shown in Fig. 6. Pumps without suction valves, in which the piston or the plunger itself controls the intake port, have a slanting groove in either the piston or the piston sleeve, and this groove registers with the opening in the piston sleeve of the piston earlier or later in the working stroke, according to the relative load. Thus it can be seen that with an engine operating at 2000 r.p.m. the injection period, being but 20 to 30 deg. of the crank takes place in a period of approximately .002 second.

The quantity of fuel injected per stroke of the fuel pumps for a 50-hp. engine is of the order of 0.004 to 0.05 cu. in. at normal loads, and 0.001 to 0.002 cu. in. at light loads. Fuel is injected through spray nozzles for the purpose of atomizing it, the nozzles having orifices varying from .008 to .0145 in. in diameter. The length of these holes is approximately .02 to .04 inch. The injection pressures vary over a wide range, with some as high as 10,000 lb. per sq. in., but usually for practical purposes in commercial engines from 1200 to 3000 lb. per sq. inch.

It is evident therefore that the fuel injection unit of the Diesel engine deserves careful and complete study by the operating end of the industry. Understanding these elements of fuel injection and what they are designed to accomplish is the first step toward understanding the operation of the Diesel engine.

In Table 1 is suggested the classification of fuel pumps and their manner of control. The study of any fuel system should begin with checking it against this chart for classification and subdivision, for the purpose of gaining an insight into its operation and function. Although space does not permit more detailed study of each class, it is well to point out the necessity for considerable additional investigation by the reader. In a later article, a detailed study of the common rail system, its operation and present day application, will be undertaken. To avoid confusion, this discussion is confined to the fuel injection unit classed as the jerk pump system.

TABLE 1

Classification of Timed Pump System

I. Part of plunger stroke used.
  1. Start fixed, end of stroke by-passed.
    (a) Valve type.
    (b) Port type.
  2. Start and end of stroke by-passed.
    (a) Valve type.
    (b) Port type.

II. Whole or plunger stroke used:
  1. Variable rate of plunger lift.
    (a) Guiberson.
    (b) Dorner.
  2. Variable plunger clearance.
    (a) Numerous variations.

III. Spring injection.

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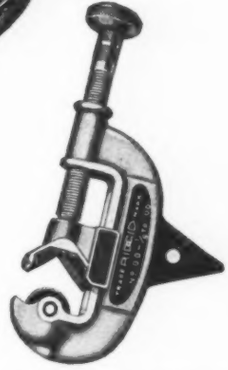

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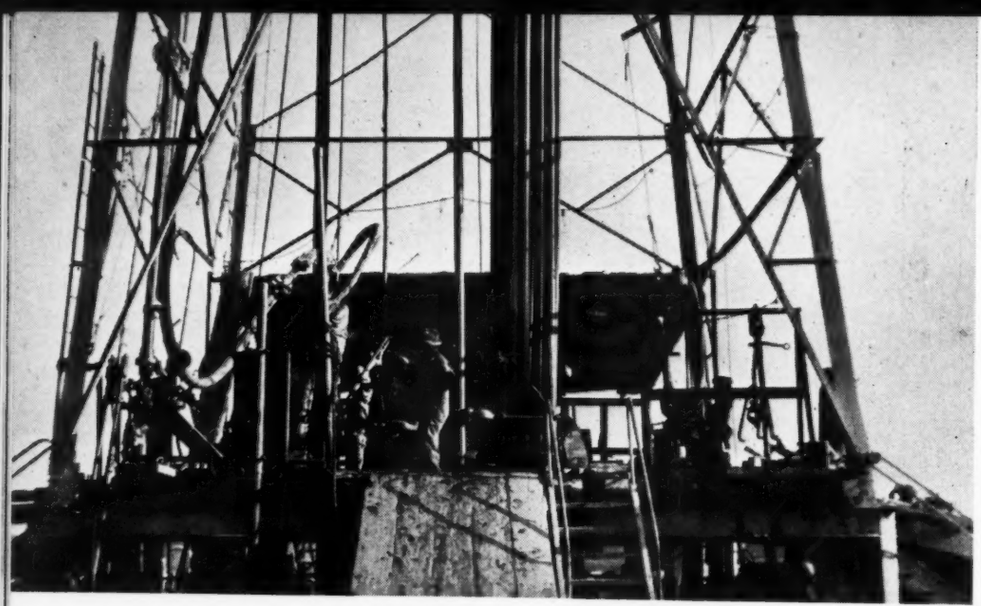

Heavy-duty rig used in drilling wells mile and a half deep in the Kent field of Galveston County, Texas. Three 125-hp. boilers supply steam at a pressure of 300 pounds

Christmas tree on the discovery well, Kent field, which is productive from depths greater than 8600 feet. On completion this well had an initial pressure of 2800 lb. per sq. inch

Deep Field Development Practice » » »

Methods of development employed in Kent field, Galveston County, Texas Gulf Coast, indicate modern trends in developing deep fields in the Gulf Coastal region.

By JOS. A. KORNFELD

PROBLEMS of deep-well drilling and completion are encountered in the Coastal Texas region at depths ranging from 8,000 to 10,000 feet. Straight-hole drilling, cementing under high temperature, overcoming extremely high gas pressure, and the use of protection strings of casing are among the many such problems encountered in salt dome fields.

Development of the Kent oil and gas field of Galveston County, in the salt dome belt of Coastal Texas, has been marked by the successful completion of wells a mile and a half deep, perforating casing in the hole at that depth, cementing under extremely high temperature, maintaining a vertical hole, and the use of welded conductor pipe.

The Kent oil and gas field is situated in the north-central portion of the county, being two miles south of the town of Dickinson and 29 miles southeast of the city of Houston. It is 15,000 ft. southwest of nearest production in the Dickinson oil field to the northeast, and is exactly ten miles northwest of tidewater, being that distance from terminals at Texas City on Galveston Bay.

Of importance from an engineering viewpoint is the type and mode of oil and gas accumulation. Geophysical studies have proven the Kent dome to overlie a deep-seated offshoot of the same salt dome plug as that of the Dickinson field. The salt is believed to lie at a depth of approximately 11,000 ft., resulting in more or less concentric structural contours on both domes, affected to a certain extent by flank faulting. Production is found in the middle Oligocene comprising the Frio sand series, known to have a thickness in excess of 950 ft. in this immediate locality. The structure was first made known by a torsion balance survey prepared for Dr. O. F. Sundt of Houston, Texas.

The discovery well for the field was brought in July 27, 1935, by the Coast Petroleum Company, their No. 1 Maco Stewart in lot 3 of the Waterman subdivision of the W. K. Wilson survey, 1400 ft. southwest of the Houston-Galveston interurban line, being completed at a total depth of 8554 feet. The producing sand was found from 8520 ft. to 8540 ft., and the well completed by means of gun-perforating of the casing at that depth.

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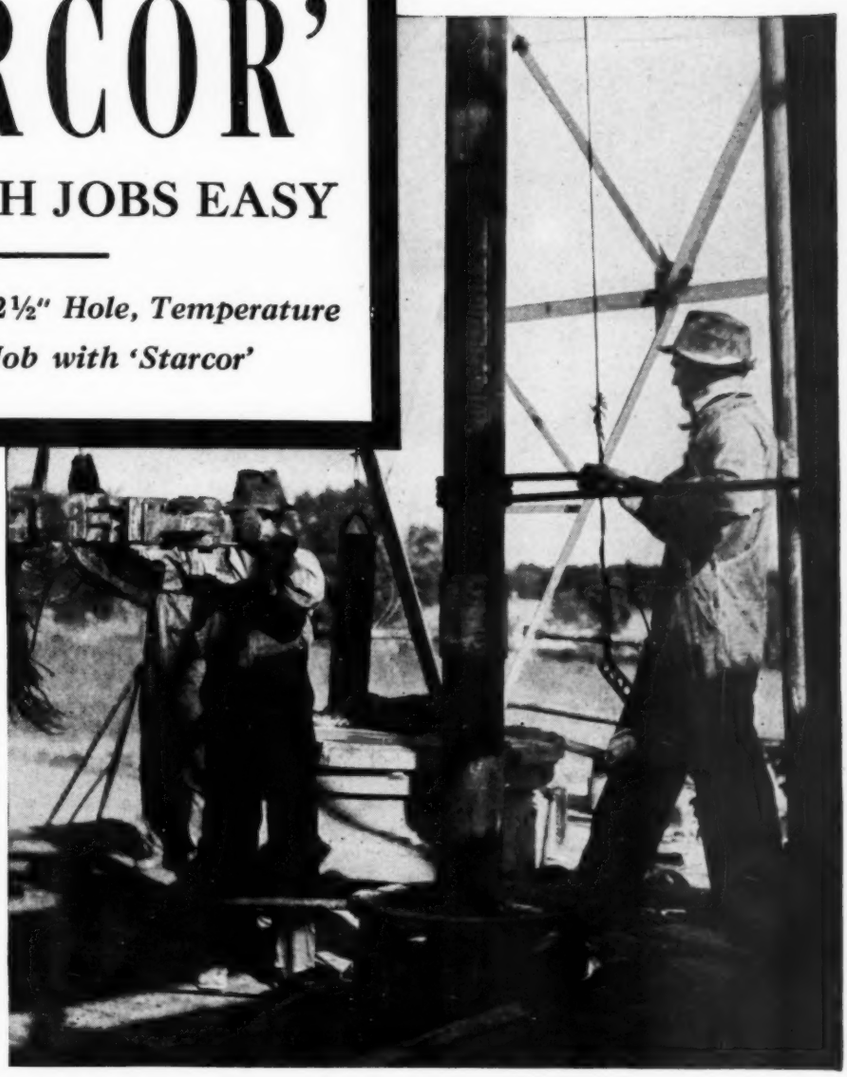
8842' of 9⅝" Casing in 12½" Hole, Temperature 200°—a 'Routine' Job with 'Starcor'



LANDING 8842 ft. of 9⅝" casing safely at the bottom of a 12½" hole isn't easy. In fact, folks who know say this well, drilled by a major oil company near Jennings, La., has about the heaviest string ever landed successfully.

Yet, with a hole plenty deep and low-down temperatures estimated at 200°, the cementing job with 'Starcor' was pretty much a routine affair.

Free-Flowing Slurry

Three Halliburton plugs were used, one ahead and two behind the cement. One guide-shoe and two flow-valves were used, at 8842, 8812 and 8782 feet, respectively, all of which offers that much obstruction to the free flow of cement slurry.

Nevertheless, 550 sacks of 'Starcor' were used in a slurry averaging 16.8 lbs. Cementing started 2:55 p. m., August 27th. All cement was in by 3:16 p. m., and placed in bottom of hole at 3:42 p. m. Final pumping-down pressure was only 1500 pounds.

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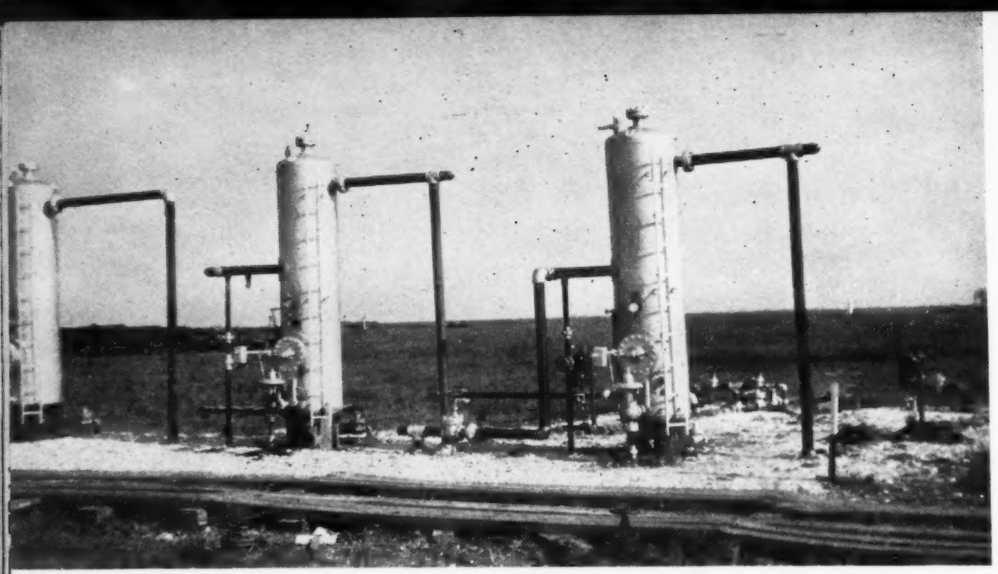

An installation of oil and gas separators on the Coast Petroleum Company's Maco Stewart lease, Kent field. They are equipped with Pilot-type dump and have a working pressure of 500 lb. per sq. inch.

Initial tubing pressure was 1700 lb., and the casing pressure 2800 pounds. The initial production was 96.94 bbl. of oil and 2,115,000 cu. ft. of gas per day through a ¼-in. choke. Pressures later increased to 2100 lb. on the tubing and 3200 lb. on the casing after the well was cleaned. Three producers were completed by the Coast Petroleum Corporation.

Ken-Ben Oil Company was the second operator to enter the development, their No. 1 Maco Stewart being completed on July 6, 1936.

Humble Oil and Refining Company entered development in July, 1936, on the east side of the field, being followed early in August by Pan-American Production Company, producing subsidiary of the Pan-American Refining and Transport Company.

In the early development of the field, operators set 64 ft. of 20-in. Kanewelded casing for conductor, using 45 sacks of cement. Kanewelded conductor, welded at the well, is employed to insure that surface water is thoroughly shut off. The surface string, composed of 1800 ft. of 13⅜-in. Kanewelded pipe, was set and cemented with 350 sacks of cement. A string of 9⅝-in. 44.3-lb. seamless casing was set at 6325 ft. with 450 sacks of cement. The oil string, of 7-in. O.D., 28-lb. seamless casing, was set at 8621 ft. with 400 sacks of cement. A string of 2½-in. 6.5-lb. upset tubing was run to a depth of 8573 ft., the same as in the discovery well. A 5-in. O.D. liner with 20 ft. of .014-mesh screen was run opposite the oil sand. Ten lines were used to run the oil string.

On future operations the Ken-Ben Oil Company has planned a different casing program, involving the use of two strings and the conductor instead of setting three strings of casing. The program now used is as follows:

Set 60 ft. of welded 16-in. conductor pipe.

Set 2745 ft. of 45.5-lb. 10¾-in. O.D. seamless surface pipe.

Set 8565 ft. of 6⅝-in. 28-lb. O.D. oil string.

An innovation in this field is the use of welding in setting the conductor pipe. Electrical welding is employed on ⅜-in. pipe of lapwelded construction to obtain increased tensile strength.

Instead of allowing the conventional 72-hr. period to elapse before drilling out the cement plugs, operators wait 96 hours because of the extremely high subsurface temperature, which is 176 deg. fahr. at the depth of the producing sand. Special cement having an initial setting time of 6½ hours, was used to cope with the high temperature.

Due to the great depth at which production is found, contractors are required to complete wells within a maximum allowable deviation of four degrees. The hole is tested every 500 ft. for verticality. The use of weight indicator equipment is standard practice. Fifty-two days are required to reach the producing sand from the time the surface pipe is set and cemented.

In completing wells, the oil string is set through the sand and the pipe gun-perforated with 45-calibre shots opposite the desired producing formation, ten perforations being made in each ten ft. of hole. The method of completion employed is that whereby the screen, liner, and packer are set with the tubing. The hole is washed first outside the screen, then a back-pressure valve in the packer is sealed

ENGINEERING DATA ON THE KENT OIL AND GAS FIELD, GALVESTON COUNTY, TEXAS

DATA	WELLS										
	COAST PETROLEUM				KEN-BEN OIL		PAN-AMERICAN		HUMBLE OIL		
	Stewart No. 1	Stewart No. 2	Stewart No. 3	Stewart No. 4	Stewart No. 1	Stewart No. 2	Craig No. 1	Craig No. 2	Maco Stewart No. 9	Maco Stewart No. 10	Maco Stewart No. 11
Conductor	20-in.	18-in.	20-in.	.....	20-in.	16-in.	16-in.	16-in.	.....	.....	.....
Surface Pipe	13⅜-in.	10-in.	13⅜-in.	.....	13⅜-in.	10¾-in.	10¾-in.	10¾-in.	.....	.....	.....
Protection string	9⅝-in.	.....	9⅝-in.	.....	9⅝-in.	.....	.....	.....	.....	.....	7-in.
Oil String	5-in.	7-in.	7-in.	.....	7-in.	6⅝-in.	7-in.	7-in.	7-in.	7-in.	2½-in.
Tubing	.....	2½-in.	2½-in.	.....	.....	.....	2½-in.	2½-in.	2½-in.	2½-in.	.....
Christmas Tree	5000-lb.	5000-lb.	5000-lb.	.....	.....	.....	6000-lb.	6000-lb.	.....	.....	.....
Liner	3-in.	5-in.	5-in.	.....	.....	5-in.	3½-in.	5-in.	.....	.....	.....
Screen Mesh	.010	.010	.010	.....	.....	4¾-in.slotted	.009	.009	.....	.....	.....
Total Depth	8543 ft.	8657 ft.	.....	8741 ft.	.....	9515 ft.	8312 ft.†	8620 ft.	8706 ft.	8707 ft.	Oil Well
Status	Oil Well	Gas Well	Oil Well	Oil Well	Oil Well	Oil Well	Oil Well	Gas/Distillate	Oil Well	Oil Well	.....
Initial Production	96.96 bbl./day ¼-in. choke	.....	555 bbl. ¼-in.choke	370 bbl.	604 bbl. ½-in. choke	125 bbl.	516 bbl. ½-in. choke	500,000 cu. ft. ½-in. choke	31 bbl./hr.	32 bbl./hr. ¼-in. choke	.....
Gravity of Oil	.....	.....	.....	.....	.....	.....	39.0	.....	38.4	.....	.....
Initial Pressure:											
Tubing	2100-lb.	.....	.....	700-lb.	.....	1500-lb.	1025-lb.	3400-lb.	1500-lb.	1700-lb.	.....
Casing	3200-lb.	2800-lb.	.....	900-lb.	.....	1850-lb.	1450-lb.	.....	1500-lb.	1700-lb.	.....
Present Pressure:											
Tubing	400-lb.*	300-lb.*	1500-lb.	.....	.....	.....	.....	.....	.....	.....	.....
Casing	3200-lb.	2750-lb.	.....	.....	1500-lb.	.....	.....	.....	.....	.....	.....
Elev. Surface	30-ft.	22-ft.	.....	.....	18-ft.	18-ft.	.....	.....	.....	.....	.....

*Bottom-hole choke used.
†Shallower pay zone.

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CONTINENTAL

and the inside of the screen washed, after which the tubing is disconnected and raised from the liner, the packer released, and the tubing entirely disconnected and then suspended for completion of the well. Bottom-hole chokes, as well as surface chokes, are employed throughout the field.

As a precaution against high pressures, a complete installation of master gate and blow-out preventer is set on top of the 13⅜-in. casing, the various connections of the installation being fastened to the casing clamps with tie-down rods and turnbuckles as shown in the accompanying sketch. The master gates are manually operated by remote control, and the blow-out preventers by pressure control from the derrick-floor. In this instance, 6000-lb. test equipment is used to handle peak pressures as high as 3400 lb. per sq. inch.

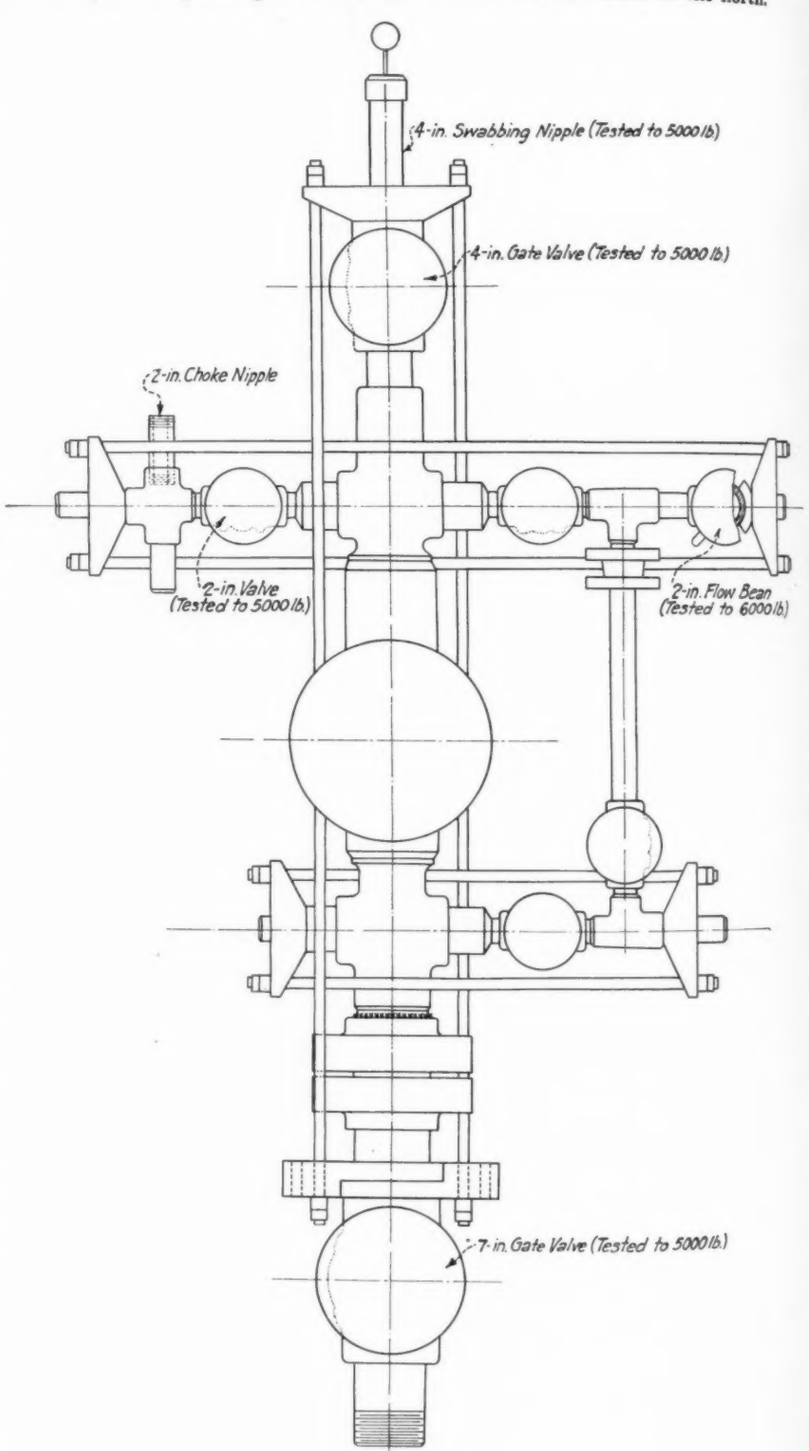
Operators begin below the surface pipe using a 9-lb. mud of 26 viscosity. As soon as the Heterostegina zone (approximately 7200 ft.) is reached the weight and consistency of the mud are changed to 10.5 lb. and 30 viscosity. While passing through the gas sands, 300 sacks of Baroid and 15 sacks of Aquagel are used in the mud to protect against the high-pressure gas.

Most of the wells are drilled on contract. Steel derricks 122 ft. in height and 24 ft. at the base are in general use. From six to ten lines are used in setting pipe. Power is supplied by three 125-hp. boilers generating steam at 300-lb. pressure. Two 7¼-in. by 18-in. slush pumps are required for this type of drilling.

Almost 700 ft. of coring was done in one well on the south side of the field, the Ken-Ben Oil Company's No. 1 Maco Stewart cored from 8180 ft. to 8669 feet. Throughout the field all coring is done with a regulation core-barrel.

In the early development of the field Christmas trees tested to 5000 lb. were employed but during the past several months standard practice has called for equipment tested to 6000-lb. pressure. Casing pressures have reached 3400 lb. on many Christmas tree installations in the field.

One interesting feature of the Kent field is the combination gas and oil pipe line outlet extending ten miles to Texas City. Since gas is shipped to several refineries at Texas City for firing boilers, the gas and oil are sent simultaneously through the line, being separated at the Texas City terminal at a separator operating at a maximum pressure of 125 lb. per sq. inch. The pipe line is operated under the name of the Bennett Pipe Line Company. In the event of production at the Pan-American Craig lease production will be handled through the Pan-American pipe line extending from the Pan-American refinery at Texas City to the Stanolind property on Dickinson bayou in the Dickinson oil field eight and one-half miles to the north.


4-in. Swabbing Nipple (Tested to 5000 lb)
4-in. Gate Valve (Tested to 5000 lb)
2-in. Choke Nipple
2-in. Valve (Tested to 5000 lb)
2-in. Flow Bean (Tested to 6000 lb)
7-in. Gate Valve (Tested to 5000 lb)

Sketch showing details of high-pressure Christmas tree connections in use on wells in Kent field

Determining an Oil Field's Possibilities for Secondary Recovery

By PAUL D. TORREY*

Schedule outlining topics for conducting a careful field study of conditions and practices before attempting to apply water-flooding or other secondary recovery methods

DURING the last year much interest has been evinced in the successful application of water-flooding to certain of the old, shallow fields of southeastern Kansas and northeastern Oklahoma, and much study has been devoted to the possibility of applying modern secondary recovery methods in other shallow productive areas in the Mid-Continent region. The selection of areas in which water-flooding or some other form of secondary recovery may be advantageously employed involves a careful investigation of the geology and the production engineering practices in the fields to be considered; and for this reason it is most important that a systematic record be kept of the pertinent facts obtained during the course of the study of the individual field.

In the spring of 1935 the Sloan and Zook Company, of Bradford, Pennsylvania, began a survey of all the oil fields comprising the Pennsylvania Grade area. An undertaking of this magnitude, requiring an individual study of approximately 300 fields, necessitated the preparation of a standard form of report on which all the data as gathered in the field or elsewhere during the course of the investigation could be set forth. Such a form of report is essential to systematic filing, and facilitates quick reference to any feature of a field that at a later date might be under consideration.

A schedule was prepared for this purpose. As the survey progressed the schedule was revised from time to time, to conform to the requirements of the engineers working in the field, and after several months had elapsed was printed in loose-leaf form with sufficient space provided to write in the information collected on the various topics by each investigator. Upon the completion of the survey of each field the field report in schedule form was mailed to the home office where it was typed and the copies bound in permanent record form. In many instances it is impossible to obtain all the information desired, but in using a standard schedule, such as this, it reduces the possibility of missing important features in connection with the fields being investigated. This schedule has proved to be a practical and workable outline, and it is believed that it can be readily adapted to conditions encountered in other regions by elimination or by expansion, as particular local circumstances may require, providing thereby a most desirable uniformity in the records needed for the compilation of production data and statistics, and for the preparation of general reports.

Here are the topics making up the schedule:

1. Name of investigator submitting report.
2. Date report was submitted.
3. Date investigation was commenced.
4. Date investigation was completed.
5. Name of field. If generally accepted name is not used give reason for change.
6. Number of field. In dealing with a large number of fields it is very convenient for filing purposes to give each field a number. The fields of Pennsylvania have been numbered by the Pennsylvania Geological Survey and wherever fields have been previously numbered by an agency of this character it is quite desirable to make the field report numbers conform, if possible, to those already established.
7. Location (show on small scale map):
   (a) County.
   (b) Section, township, and range.
   (c) U. S. Geological Survey Topographic Quadrangle or Areal Survey Plat.
   (d) Quadrant of Quadrangle. In unsectionized regions, topographic or areal maps, if available, are generally the best base that can be used for determining the outlines of the fields.
8. Discovery date. Note date of any deeper drilling.
9. Age of field from each productive horizon.
10. Have you collected all available information? If not, give your recommendations for further procedure with possible sources of information. Many times well records, production statistics, and other pertinent information cannot be obtained in the field at the time of the investigation, and the report therefore will have to be supplemented at a later date when the desired data are obtained.
11. Whom did you interview concerning this field? Give full names, titles, addresses, and telephone numbers.
12. Which ones seemed most interested in the investigation? This information and that contained in the preceding topical heading are many times quite valuable to company executives who may desire to negotiate for the acquisition of property in the field.
13. Brief history of development of the field. This should include, if possible, a list of the active operators while the field was being developed, rate of development (that is, how rapidly the field was drilled), market and price paid for the oil at the time of development, and any other pertinent historical facts that might affect modern reworking operations. Note effect on development of discovery of new sands.
14. Area of field in acres. Show by individual field map drawn to some convenient scale; also show, if possible, the location of all wells drilled, indicating by conventional symbols such wells that have been abandoned due to depletion or water encroachment, the

*The Sloan and Zook Company, Houston, Texas.

wells that are now producing, and whether each well produced oil, gas, or water, or whether the sand was missing or was tight and barren.

15. Stratigraphy of field. Give typical well records, and locate the wells from which records have been obtained on the field map and give the casing-head elevation. Give general information regarding the various formations encountered, their thickness, continuity, and lithology. Note any important convergence in the field and prominent unconformities. Logs of deep-test wells are particularly important.

16. Structural conditions. Try to acquire all structural data that can be obtained, giving proper recognition to the source of information. Note the relation between the occurrence of oil, gas, and water to structural conditions. Note any prominent indications of faulting or unusual position of any rocks. Take advantage of all published reports, and supplement these with any more recent data that are available. Compare surface and subsurface structure.

17. Name of sands encountered. Note whether they carry oil, gas, water, or are dry.

18. Average depth of each sand, including sands that carry fresh water. Note average interval between sands and horizon markers that are customarily identified by drillers.

19. Average thickness of sand.

20. Variation in thickness of sand throughout field.

21. Character of sands. For each sand try to obtain the following information:

(a) Composition of sands, whether coarse- or fine-grained, or conglomeratic; mineral composition of sand; occurrence of nodules and concretions; whether sand is cross-bedded, blocky, massive, or flaggy; and whether there are any indications of pronounced open joint planes or crevices of any kind. Type of cementing material. Are drill cuttings well or poorly cemented? Is the cementing material clayey? What is the chemical character of the cementing material? Are the sand grains round or sharp? Does the sand wear the drilling bit fast or slowly? Porosity, permeability, and oil content of sand. Presence of shale breaks. All physical and petrographic characteristics that can be ascertained, such as secondary cementation, metamorphism, etc.

(b) If oil or gas occurs in limestone reservoirs, fully describe the mode of occurrence, whether in interbedded sandstone lenses, solution cavities, coral reefs, fractures, or joints, or along bedding planes or formation contacts.

(c) Nature of cap rock, type of bed, hardness, color, presence of water above, etc.; also note characteristics of rocks beneath the sand, and describe any shale replacements in the top or bottom. Note any irregularities in the contact of the sand with overlying and underlying beds.

(d) Does oil, gas, or water occur immediately below the cap rock? If present, in what quantity?

(e) Does oil, gas, or water occur in entire sand body or in definite lenses or pays? What separates pays? Estimate thickness of pays. Give position and place in the sand if oil and gas do not occur in the same pay.

(f) Did oil production occur where the sand was easy or hard to drill? Does the sand drill uniformly throughout its entire thickness; if it does not drill uniformly give position in sand of hard and soft phases.

(g) What color is the sand? Is the color due to the cementing material? Is there any variation in color of the sand from the top to the bottom?

(h) What is the color of the water that is bailed out while the sand is being drilled? Do the cuttings indicate the type of cementing material, and the character of the rocks above and below the sand?

(i) Initial production of wells, both oil and gas. Did all the wells have reasonably uniform initial productions in barrels of oil and cu. ft. of gas? If not, where were the largest wells found? Where were the smallest wells found? Compare the productive life of large and small wells. Were large oil wells accompanied by more gas than the small wells? Was the sand less porous where small wells occurred, or was it merely thinner? Were wells smaller on the edge of the field? If so, what was the cause? Was the life of edge wells shorter than the center wells? Did edge wells have more or less gas than center wells? Were there any dry holes in the field during the original period of development? If so, how can you account for these? Discuss all other reasons that you find that may account for variations in initial production of wells.

(j) Does the sand show any marked variations throughout the field in thickness, porosity, permeability, saturation, thickness of pays, cementing material, and inclusions of shale or shale breaks? Does the sand contain shaly phases or shaly areas? Describe and locate, and give extent, thickness, and number. Is the pool limited by variations in sand porosity, by thinning of sands, by gas production, or by water in the sand? What effect has structure in defining the limits of the field? Note effect of unconformities and discomformities.

(k) Does gas occur in the oil sand and in what quantity? How much gas was produced along with the oil? What is the present gas-oil ratio? If the initial production of gas was large enough to require the use of separators, how long did the big gas production last? Was gas wasted in the field? How many wells producing both oil and gas are there in the field? Note all wells that produce a preponderance of gas. Estimate from such information as can be obtained the total gas production from wells producing both oil and gas. Are any of these combination wells abandoned? If either oil or gas production in combination wells has been separately abandoned, state why.

(l) Relation of gas, oil, and water in the sand. If water is restricted note what part of sand it occurs in. Did all wells in the field show water in the beginning or just wells in certain parts of the field? If so, what parts and why? If water was found with the oil or gas was it fresh or salt? If fresh or brackish water is found in the sand does it indicate natural floods from leaky casing or abandoned holes? Estimate quantity of water produced at the beginning of the productive life. State if water came in during last few years. How old were the wells when it appeared? If water is fresh where did it come from? Estimate quantity.

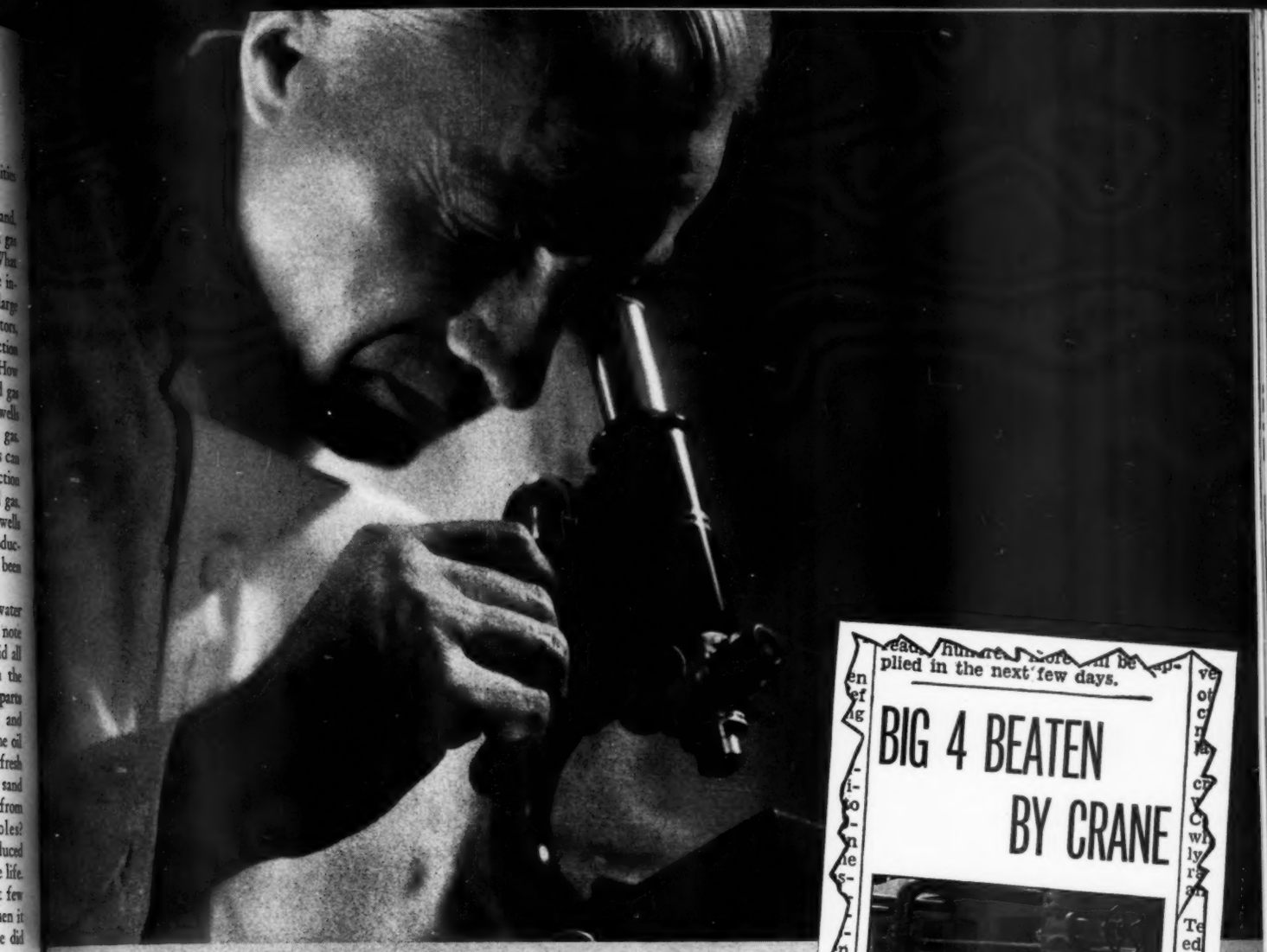
(m) Get all information, if possible, on cores that have been taken of the sand. Try to get cuttings of the sands for laboratory examination. If any wells are being drilled in the field try to observe the actual drilling of the sand, and obtain all possible information on its character and oil content.

22. Original rock pressure. Did the wells flow or did they have to be pumped from the beginning of production?

23. Decline in rock pressure and production. If possible get representative decline curves for the field and for individual properties. Try to segregate the production from each sand in fields where oil or gas is produced from more than one horizon. In multiple sand fields, which sand seems to be most important?

24. How does the initial production of recently completed wells compare with initial productions of the first wells drilled in the field?

25. Get a two-quart sample of oil from each field. If production is coming from more than one sand try to get samples from each horizon. The samples should be as representative as possible and preferably should be taken while the wells are being pumped or



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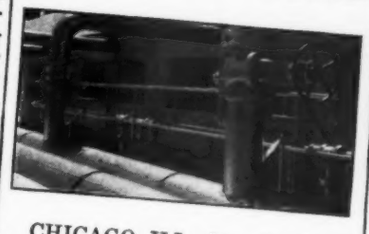

CHICAGO, ILL., Dec. 21—High temperatures, high pressures, corrosion and erosion are the "Big Four" enemies of production and refinery engineers in regulating the flow of liquids and gases.

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flowed rather than from tanks. Mark each container with the following data:

Oil Sample Data
- Sample Number
- Well Number
- Property
- Company
- Township
- County
- Field
- Date Taken
- Depth of Well
- Sand and depth of sand
- Remarks

Samples of the crude produced are very important, because the viscosity of certain oils is not suitable for water-flooding, other oils have a great tendency to emulsify when water pressure is applied to the sand, and many oils will be seriously oxidized by air-repressuring. A careful study of the physical and chemical properties of the crude is most desirable before attempting reworking operations.

26. Oil production of field; original and present by years or by months. When was the peak of production reached?

27. Oil production per well—average for the field or on representative properties. Present daily production. Average life of wells. If possible give average gross production for each operator in the field.

28. Availability of gas for possible future operations.

(a) If sufficient gas for repressuring or general operations is not available in the field give sources of additional supply. Tell where these sources are.

(b) Who owns the gas at various sources?

(c) To whom is it sold?

(d) At what price per thousand cu. ft.?

(e) Is the supply adequate for operation by repressuring over a long period?

(f) Is there any distress gas available?

(g) Are gas lines available in or near the field?

(h) If not, how much pipe line would have to be laid to provide the field with gas?

(i) What are the gathering line pressures at source of additional gas supply?

(j) What is the main line pressure?

(k) What is the average closed-in rock pressure at the source of additional gas supply?

(l) When were the gas wells drilled?

(m) What was the maximum, minimum, and average open-flow capacity of the wells?

(n) What was the original rock pressure at all sources?

(o) Have these wells been drawn on heavily at any recent date?

(p) If trunk lines cross or are near the field what would gas cost?

(q) Give any other data that may affect source of available gas supplies outside the field.

(r) If supply of gas is available in the oil field give number of wells.

(s) Give total open flow of wells.

(t) Give average rock pressure.

(u) Give average gathering line pressure.

(v) Give average main line pressure.

(w) Give date gas wells were completed.

(x) Give original rock pressure.

(y) Give original open-flow capacity.

(z) Have these wells been drawn on heavily at any recent date?

(aa) Do you consider the gas reserves of the field adequate for repressuring or general operating over a long period of say 20 years?

(bb) Can gas be bought in the field? Is it being sold at the present time?

(cc) From whom?

(dd) At what price per thousand cu. ft.?

(ee) Give as complete as possible a gas history of the field.

29. Water conditions in field:

(a) Obtain a representative sample of connate water from each producing sand, being particularly careful regarding the certainty of its source. Is the connate water corrosive to casing, tubing, and other production equipment? A study of oil field waters is very important from the standpoint of problems of corrosion, and also due to the fact that certain oil field waters carry sufficient quantities of soluble calcium and magnesium salts to form large quantities of insoluble precipitates when fresh water, carrying appreciable quantities of soluble carbonate salts, is introduced into the sand. Serious plugging of the oil sands has resulted from this action in several areas.

(b) In areas where conditions appear to be favorable for water flooding take samples of ground water from springs, wells, and from any samples that might afford a permanent water supply. In such fields make a thorough investigation of water resources and report fully on any particular problem of water supply that would have to be considered in water-flooding operations. Give name of streams. Approximate area of watershed. Average annual rainfall in inches. Flow per second feet during various times of the year. Is the stream subject to sudden rises; if so, when? What is the effect of dry weather on flow? Is the water generally clear or turbid? Is it polluted by mine water? Explain any pollution and its extent. Is it corrosive? Are there suitable dam sites in or near the field? If so locate these on a topographic map. Are the streams used for domestic or industrial water supply? Would the removal of large quantities of water create a health problem by the slowing down of sewage movement? Would the removal of water be a damaging factor to any active or proposed irrigation project?

Give all available information concerning subsurface water supplies. Is the water clear? What is the average depth and thickness of water-bearing strata? What is the average production per minute per well? Are there any artesian sources of water supply? Has continued withdrawal of water from artesian wells diminished the pressure, and from non-flowing wells has the water table been lowered? If so, how much? Was fresh water encountered in drilling for oil and gas that is not being used? If so, at what depths and how much?

Water Sample Data (label each sample as follows):
- Sample Number
- Well Number
- Property
- Company
- Township
- County
- Field
- Date Taken
- Depth of Well
- Source of Water
- Remarks

An adequate and reliable source of good quality water is absolutely essential to successful water-flooding operations. Careful analyses should be made to determine whether water treatment and filtration is necessary before any attempt at flooding is made.

30. Past and present development and operation.

(a) Drilling, kind of rig, special difficulties in drilling, cost, etc.

(b) Casing Record:
- Size.
- Average amount put in wells.
- Average amount pulled.
- Average amount left in wells.
- Is casing in good condition?

(c) Amount and size of tubing used.

(d) Packing or cementing; purpose of this.

(e) Shooting; quantity and type of explosives used, how shots are placed in reference to top and bottom of sand, general results of shooting. How many wells have been shot? How many have not been shot? If possible locate the

latter on a map. What have been the general results of shooting?

(f) Pumping or other production equipment used; get costs if possible. Note condition and type, powers, jacks, engines, sheds, and houses. How often are wells pumped? What percentage of rigs are wood and what steel?

(g) Storage facilities; condition of tanks and gathering lines.

(h) Method of separation of oil from water. Treatment of emulsions if any.

(i) Other problems of operation such as paraffin, rugged topography, inaccessibility, etc.

(j) Give details of cleaning-out procedure. Are the wells now free from paraffin and B. S.? If not, state actual condition. Are wells cleaned out regularly or intermittently? Do mineral salts tend to accumulate on the face of the sand and in the tubing? Are the wells generally reshot after being cleaned out? Do you think that production is being affected by cavings or bridges? What are the general results of cleaning-out jobs?

(k) Number of wells producing. Average well spacing.

(l) Number of wells abandoned. How long have they been plugged? Why were they abandoned?

(m) Were the old holes properly plugged or poorly plugged?

(n) Reworking, or secondary recovery, operations. Note particularly for water-flood:

Well spacing.
Intake pressure.
Volume of water input for each well.
Production.
Recovery results.
Duration of operations.
Area affected.
Was flooding accidental or intentional?

(o) Reworking, or secondary recovery, operations. Air or gas repressuring:

Well spacing.
Intake pressure.
Intake volume.
Results of operations.
Duration of operations.
Area affected.

Does the use of air tend to reduce quality of the oil?

(p) Has vacuum been used? Are gasoline plants still in operation? How much vacuum has been applied and for how long? What have been the results? Has the use of vacuum lowered the gravity of the oil? What has been the average recovery of gasoline from the casinghead gas? What type of gasoline plant is used? What is the average daily production of casinghead gasoline? What is done with the stripped gas?

(q) Have any wells been treated with acid? List and locate these. How much acid was used? How much oil was used for tamping? What have been the results of the treatment?

(r) Note particularly any unusual equipment or recent improvements in operating technology.

31. Discuss any problems of lease or royalty ownership that might make unitization of the field difficult. Note any production agreements other than the usual one-eighth royalty. Is there formerly productive acreage, the wells on which are now abandoned, that might be acquired either by lease or by purchase? Under what terms might such land be acquired?

(32) Present markets for oil.

(a) Grade of oil such as Buckeye, Eureka, Lima, etc.

(b) Pipe line facilities. Are they in good condition? Give ownership.

(c) Are the main storage tanks in good condition?

(d) How frequently is the oil run?

(e) Who buys the oil?

(f) Is the oil regarded as being a desirable crude?

(g) Refinery connections. Are they adequate, and to what point is the oil delivered?

(h) Current price paid and any premiums.

(i) Nearness to rail, water, and highway transportation, and proximity to electric power lines.

(j) Is any oil distributed by tank cars or tank trucks?

(k) Give outline of transportation facilities during all periods of the year.

33. Estimation of past recovery per acre and reserves remaining in the sand. Take individual properties if information cannot be obtained for the entire field.

34. Suggestions for best method of reworking if reserves available justify further investigating and testing. Express an opinion regarding the desirability of making a detailed subsurface structure map, if none is available, and for core-testing the sand.

Acknowledgments

R. T. Zook, president of The Sloan and Zook Company; Prof. Clark F. Barb, of the Department of Petroleum Engineering, Colorado School of Mines; the late James D. Sisler, State Geologist of West Virginia; and Max S. Loy, petroleum engineer of the Sloan and Zook Company, coöperated with the writer in the preparation of this schedule.

Mercury-Vapor Steam Units

TWO new mercury-vapor steam units of small capacity have been installed at Lynn and Pittsfield, Massachusetts, for the generation of electric power and steam by means of a mercury boiler, a mercury turbine, a condenser boiler, and a steam turbine. In both equipments, the mercury turbine is rated at 1000 kw. and, in addition, 12,500 lb. per hr. of steam is supplied by the condenser boiler at 185 lb. per sq. in. gauge pressure and 160 deg. fahr. superheat, says John Liston, of the General Electric Company, in his annual review of the electrical industry.

The mercury boiler at Pittsfield is of the natural-circulation type, with tubes similar to those in the liquid-cooling walls in the large boilers at Kearney, New Jersey, and Schenectady, New York. The boiler at Lynn is of the forced-circulation type. All the heating tubes are filled with liquid mercury, and all the vapor is formed in a separate chamber remote from the combustion space. The hot mercury is discharged from the heating tubes through a nozzle, which drops the pressure and releases the stored heat of the liquid. This causes a portion of the liquid mercury to flash into vapor. The pressure in the heating tubes in approximately 200 lb. per sq. in. greater than the pressure in the flash chamber. The operating temperature of the tubes is no greater than the temperature in the tubes in the large natural-circulation boilers now in service.

Designs already have been prepared for a mercury-steam installation of 44,000-kw. capacity that will use but a single drum, and there will be no dead-ended porcupine tubes and no water walls in the furnace.

Advances in Technique of Chemical Investigation

IMPORTANT advances in the technique of chemical investigation have been made recently, enabling minute samples of materials, only a few millionths of a gram in weight, to be analyzed almost as completely as samples of many grams weight have been in the past. Electrolysis, fractional distillation of single drops absorbed by asbestos fibers, and spot-analyses by taking a print of the specimen on paper impregnated with a sensitive reagent, are some of the novel methods used in the new microchemistry, states P. L. Alger, of the General Electric Company, in reviewing the progress of engineering knowledge during 1936.

THE 1936 ROLL CALL OF WHO USE OUR PRODUCTS

One of the most difficult tasks of the advertiser is to keep his statements regarding his own products wholly unprejudiced. American Hammered publishes this "roll call" of America's major equipment manufacturers —virtually a blue book of American industrial leaders—because the mere mention of their names is perhaps the most eloquent endorsement of our products that could be advanced.

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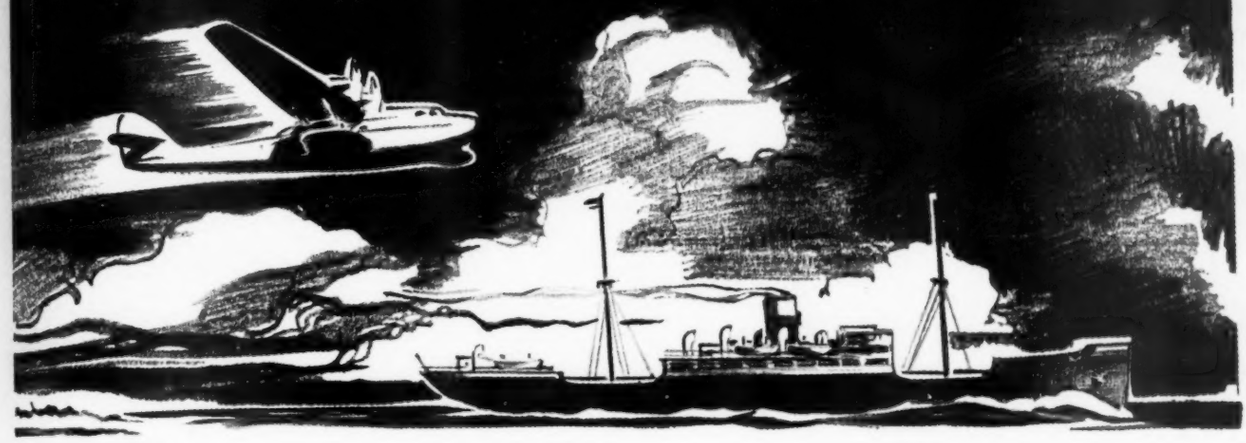

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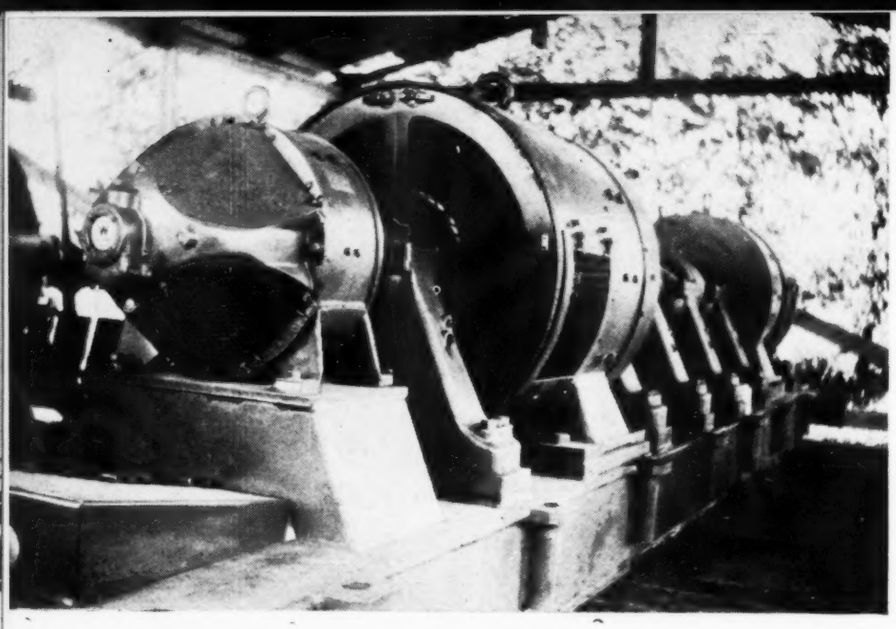


Electrical drilling equipment of Shaffer Drilling Company well at Gainesville, Texas

By

D. H. LEVY[2] and

W. C. DREYER[3]

Direct-Current Oil Well Drilling Equipment[1]

A discussion of d-c. power and equipment as employed in modern rotary drilling practice

D-C rigs, with but few exceptions, are essentially the same. They consist essentially of two main generators, one or two exciters, a drilling motor, one or two mud pump motors, and control and auxiliary equipment. In all instances this equipment comprises a variable voltage system wherein the motors are completely controlled by varying the generator fields.

During drilling the usual rig operates with one generator supplying power to the mud pump motor and the other supplying power to the drawworks motor, which is used for rotating the drill pipe. Both generators are connected electrically in series or parallel to the drawworks motor when hoisting drill pipe out of the well.

The main motors are separately excited, shunt-wound. The motor fields are constantly excited in one direction and the motor armatures are connected to the generators except when the motors are stopped or when changing the electrical connections. The speed and direction of rotation of each motor are a function of the power coming from the generator and vary with the generator voltage and direction of flow of the generator current.

Constant excitation of the motor fields in one direction makes stopping, starting, and reversing the motor much more rapid, since the time required for the field flux to die down and build up is eliminated.

Forced ventilation of the motors permits stalling or operation at low speed without excessive overheating. When explosive gases are present these blowers may be used to ventilate with air from a pure source.

The first d-c. rig, which is today in operation in New Mexico, answers this same general description except the motors were compound-wound instead of shunt-wound. As pointed out by A. H. Albrecht,[4] the compound motor has a rapidly-rising characteristic that gives better use of the engine capacity for hoisting. This advantage is now considered more than offset by the increased control complication resulting in an almost universal use of shunt motors on both the drawworks and mud pump.

A recent variation to this general set-up was a rig employing five generators with control so arranged that any combination of generators from one to five can be connected in series to either the mud pump motor or the drilling motor. The use of a multiplicity of smaller generators has no elec-

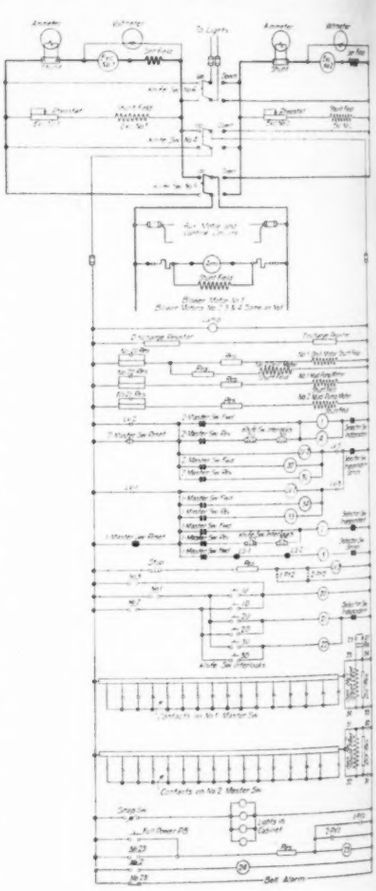
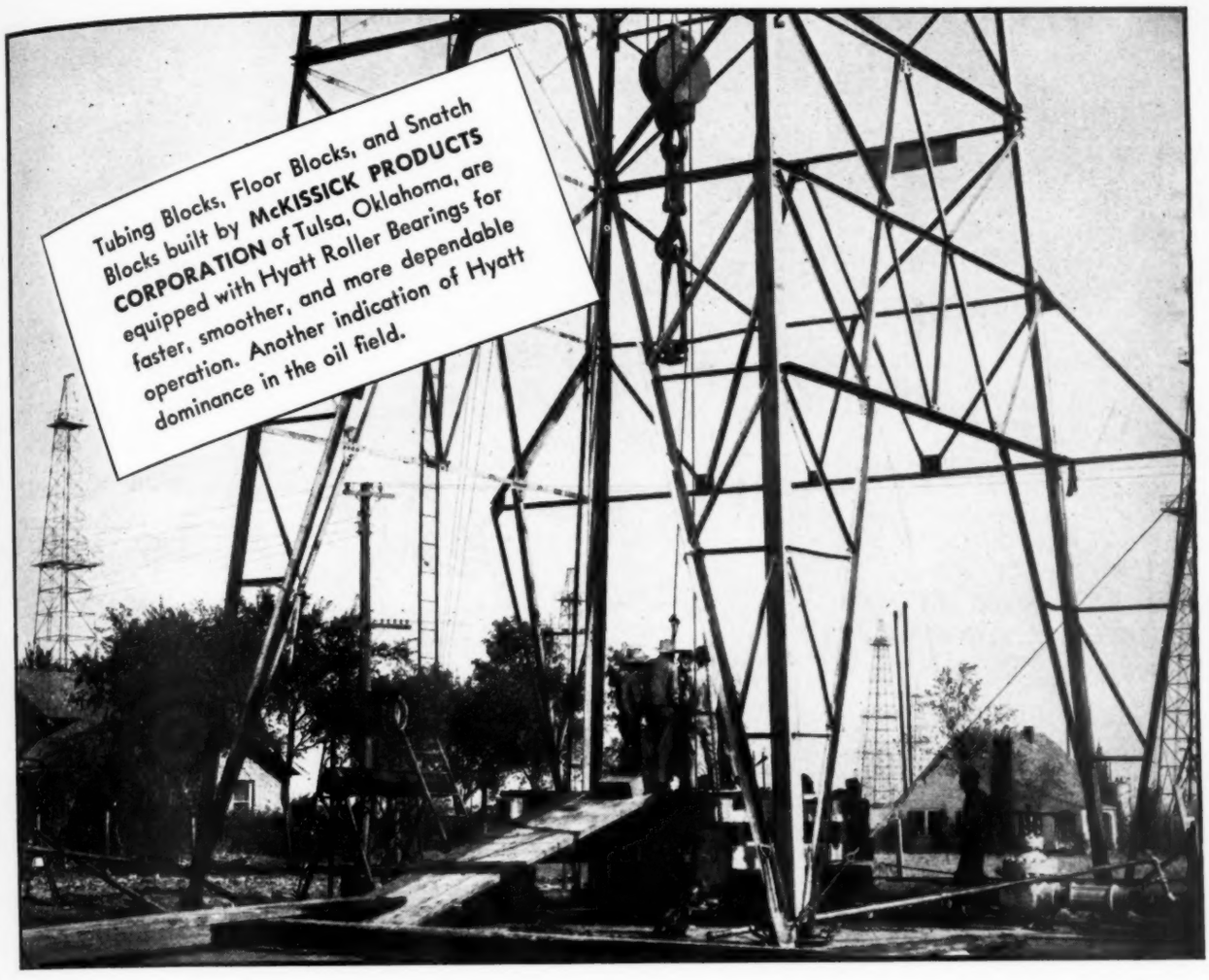


Diagram of control and auxiliary circuit of variable voltage d-c. drilling equipment

[1]Abstract of paper presented before the Southwest District Meeting of A.I.E.E. at Dallas, October 26-28, 1936.
[2]Magnolia Petroleum Co., Dallas, Texas.
[3]Westinghouse Electric and Manufacturing Co., Dallas, Texas.
[4]"Varia-Voltage Oil Well Drilling Equipment," A.I.E.E. Winter Convention, January 23, 1933.


Tubing Blocks, Floor Blocks, and Snatch Blocks built by McKISSICK PRODUCTS CORPORATION of Tulsa, Oklahoma, are equipped with Hyatt Roller Bearings for faster, smoother, and more dependable operation. Another indication of Hyatt dominance in the oil field.

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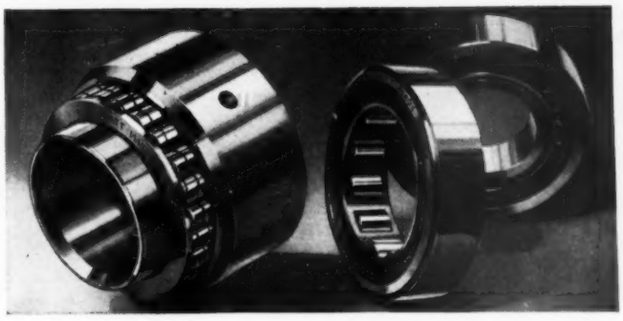
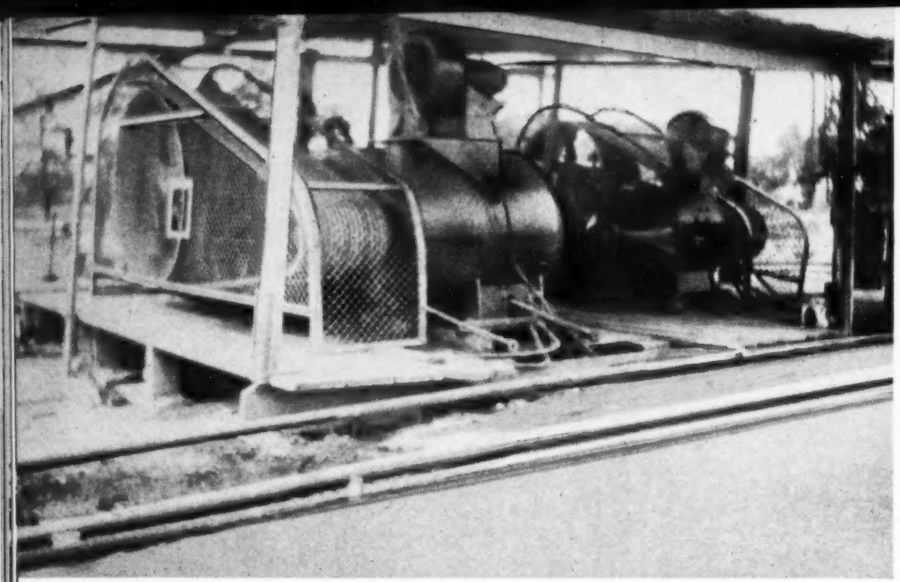




Electrical drilling equipment on operation in Southern Oklahoma, owned by Loffland Drilling Company

trical advantage but permits the use of smaller engines, each operating mechanically independent.

Generators. The suitability of d-c. power for drilling is entirely due to characteristics obtained by the proper choice and design of generators. Each generator is provided with three fields proportioned to give the generator a drooping voltage characteristic. With increased current the generator voltage drops off and falls to zero at a load of approximately two times full-load current on the generator. Limiting the current in this manner limits the maximum torque to approximately two times full-load.

Reasons for Three Fields. For the most effective use of the electrical capacity it is desirable to maintain the voltage of the generator constant with increasing load up to the stalled current condition and then have it fall off approximately to zero. In terms of torque and speed this means maintaining the speed constant up to a certain torque that is the limit of torque required and then having the speed drop to zero with the torque remaining constant. From an operating standpoint this is not ideal as it is advantageous to have the motor speed drop off with increased torque to reduce the peak load on the prime mover. The ideal characteristic may be more closely approximated with a 3-winding generator than with a differential generator having separately-excited shunt field only. A straight differential generator with separately-excited shunt field drops very fast, since the entire field flux is produced by the separately-excited field and more differential series field is required to reach the same stalled point as with a 3-winding generator. In the case of the 3-winding generator the self-excited field sets up part of the flux and as the generator voltage drops off the self-excited flux decreases and helps to decrease the total flux so there is not so much differential series required. Consequently the series ampere turns for the 3-winding generator are less for a given value of current and the voltage is maintained at intermediate points between the no load and full load at a higher value than is obtained with the differential generator with separately-excited field only.

The use of a differential series field with self-excited shunt field is out of the question because the maximum current can decrease at but one point regardless of the field strength and that point is when residual flux is opposed by the differential series ampere turns to give zero voltage. As already stated, the self-excited field has no effect at zero voltage. (See Curve No. 1).

The motor speed range required makes it desirable to control both the self-excited and the separately-excited generator fields. This is usually done by varying resistance in the separately-excited field circuit with the lower speed points of the controller, and in the self-excited field circuit with the higher speed points. Strengthening the separately-excited field increases the motor speed and stalling torque simultaneously. The self-excited field influences the speed but does not affect the stalling torque, so the motor is permitted to exert its maximum torque on a control point that gives it a moderate speed at light loads.

Some control of the self-excited field is essential for smooth motor operation, using the 3-field generator. If the self-excited field were left constantly excited the generator voltage would build up with the controller in the off position and the motor would start with a jerk on the first point. It would immediately drop in speed as the differential field bucked down the flux of the self-excited field.

Limited Peak Kw. These three fields properly proportioned give the generator a voltage characteristic that allows the kw. output to increase as the load current increases up to a predetermined point. After this point is

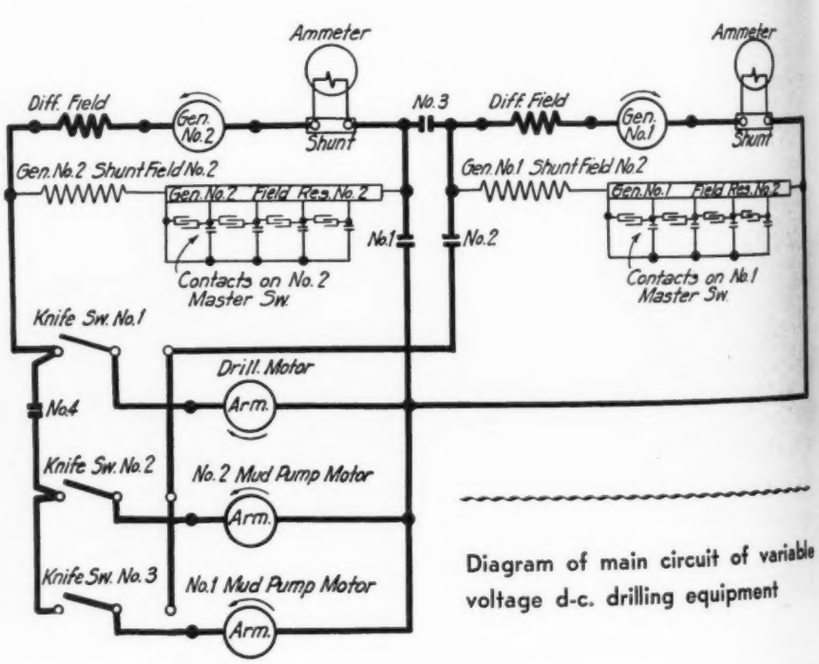
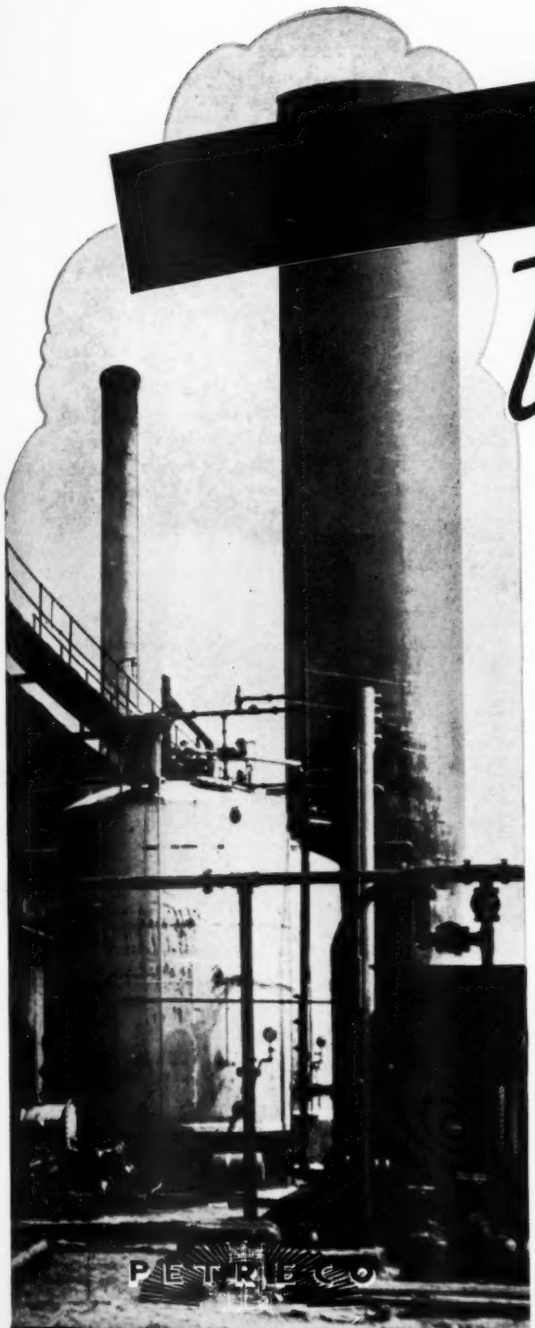


Diagram of main circuit of variable voltage d-c. drilling equipment



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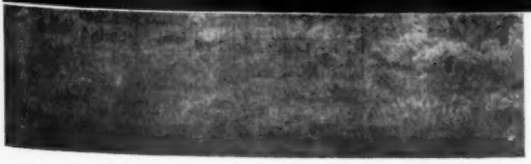
The many difficulties resulting from salts in petroleum are well known to all refinery executives. The important advantages resulting from efficient salt-removal, however, are not so well recognized. Doubtless this may be attributed to the fact that heretofore there has been no commercially feasible method by which the salt content of large volumes of oil could be eliminated, or reduced to a satisfactory minimum; many refiners accepting as inevitable certain operating conditions that primarily are due to this cause.

One of the most outstanding among Petreco's recent activities has been extensive research and development work in the removal of salts from crude charging stocks. Plants now operating clearly demonstrate that the difficulties resulting from salts in petroleum can be entirely eliminated; and that the additional advantages which follow are of utmost importance to refiners of crude petroleum.

Every oil company executive in any way affiliated with refining operations should be fully informed of the results obtained with this process in actual service. Complete details are available on request, without obligation.



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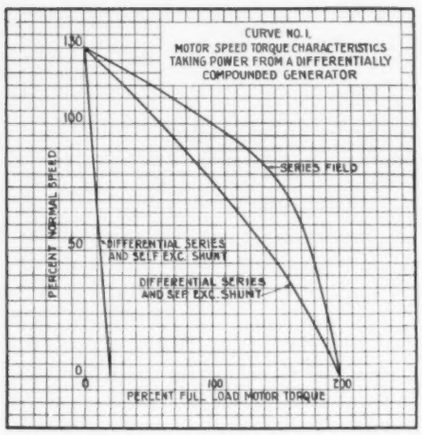


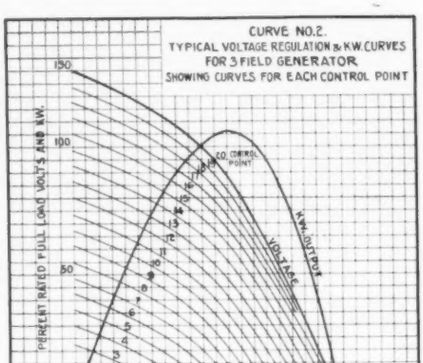
reached the voltage falls off faster than the current increases so the kw. output decreases until it reaches zero. This means that there is a definite predetermined value of maximum power required to drive the generator regardless of the torque load put on the motor. Adjustment of the generator voltage characteristics and of the peak value of kw. the generator will deliver, is made by reproportioning the separately-excited and the self-excited shunt fields. This may be done by changing resistance values in the field circuits after the generators are in service.

The technique of controlling the value of peak power by means of field adjustment is to increase the separately-excited field until maximum generator current is approached at stalled motor condition. This is usually twice the full-load amperes. If the desired power peak has not been reached the self-excited field is increased until it is reached. The no-load motor speed should then be checked for overspeed and adjusted to a correct value by motor field adjustment, with the generators operating at full field, i.e., with the controller all the way around.

Speed Torque Curves. The generator voltage characteristics are of importance because the motor speed and direction of rotation are a function of the generator voltage. The generator voltage at any time is dependent upon the load and the setting of the field rheostats in each field circuit. The voltage-load ampere curve for any given setting of the rheostat depends upon the saturation curve of the machine and upon the speed regulation of the prime mover driving the generator. These curves also are influenced by any variation in the exciter speed. In those instances where a direct-connected exciter is used with an engine-driven generator the exciter speed varies with the engine speed according to the engine speed regulation. Any change in the exciter speed causes a change in exciter voltage, which directly influences the separately-excited fields of the generators and motors. It is customary to design exciters so that variation in its load has little effect on the exciter voltage.

A 3-field generator with its field resistances gives a definite family of volt-ampere curves corresponding to various points on the controller. An example of this is shown by Curve No. 2. The motor terminal voltage may be calculated from these curves by correcting them for line drop. If the voltage drop through the armature circuit of the motor is known it may be subtracted from the voltage at any point on any of the motor terminal volt-ampere curves and the resultant curves obtained are exactly proportional to the motor speed torque curves with a constant motor field excitation.

Motor Field. Although the motor field is not changed during the operation of the drilling equipment, it is customary to provide a resistor with adjustable tap in the field circuit. This



resistor is adjusted at the time of starting up the equipment to give the desired motor speed torque characteristic and this speed torque characteristic is constant for that particular combination of generator field values. The motor speed is controlled during operation by changing the generator field values and the motor field readjusted only when changed drilling condition make different motor characteristics desirable.

Weakening the motor field increases the motor speed and decreases the motor torque for the particular generator field values.

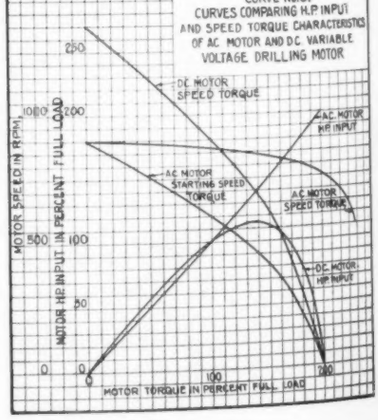
Operating Advantages of Direct Current. It is obvious that the drooping characteristic and the limited maximum hp. of the motor have signal advantages for rotary drilling equipment drive. The fundamental reason for using d-c. equipment for transmitting power from an internal combustion engine to a drilling rig is that the engine characteristics are entirely unsuited to a drilling load. One of the advantages of the engine is the fact that it is primarily a constant speed source of power. The a-c. motor of the most efficient types also are constant-speed drives and speed reduction is usually obtained at a sacrifice of efficiency. At reduced speeds the efficiency of d-c. remains high since the speed of the d-c. motors is controlled by varying the generator fields when only small current is used.

With d-c. equipment and properly proportioned generator fields the peak loads taken by the rig are held within the rating of the prime movers, eliminating the possibility of stalling motors or drawing excessive peak loads from the power line. The proportioning of fields limits the maximum current that can be drawn from the generators, thereby making it possible to stall the motors for a short time without damage.

Slow motor speeds at light loads are obtained with d-c. by merely reducing the generator fields. The motor speed is fairly stable with load variation at light loads.

With full field on the generators the no-load speed of d-c. motors is higher than that of a-c. motors. This is because there is no speed limitation due to line frequency. The generator voltage at no-load is adjusted to give a no-load speed limited only by the mechanical strength of the rotor banding and speed for good commutation. High motor speed at light loads is of advantage in hoisting empty blocks.

One point in favor of d-c. drives as compared with a-c. drives is that for the same hoisting duty smaller engines may be used with the former. The reason for this is that an a-c. motor speed is a function of frequency of the alternating current and the motor peak input depends upon the motor torque and not upon the motor speed. With d.c. the speed of the motor is a func-



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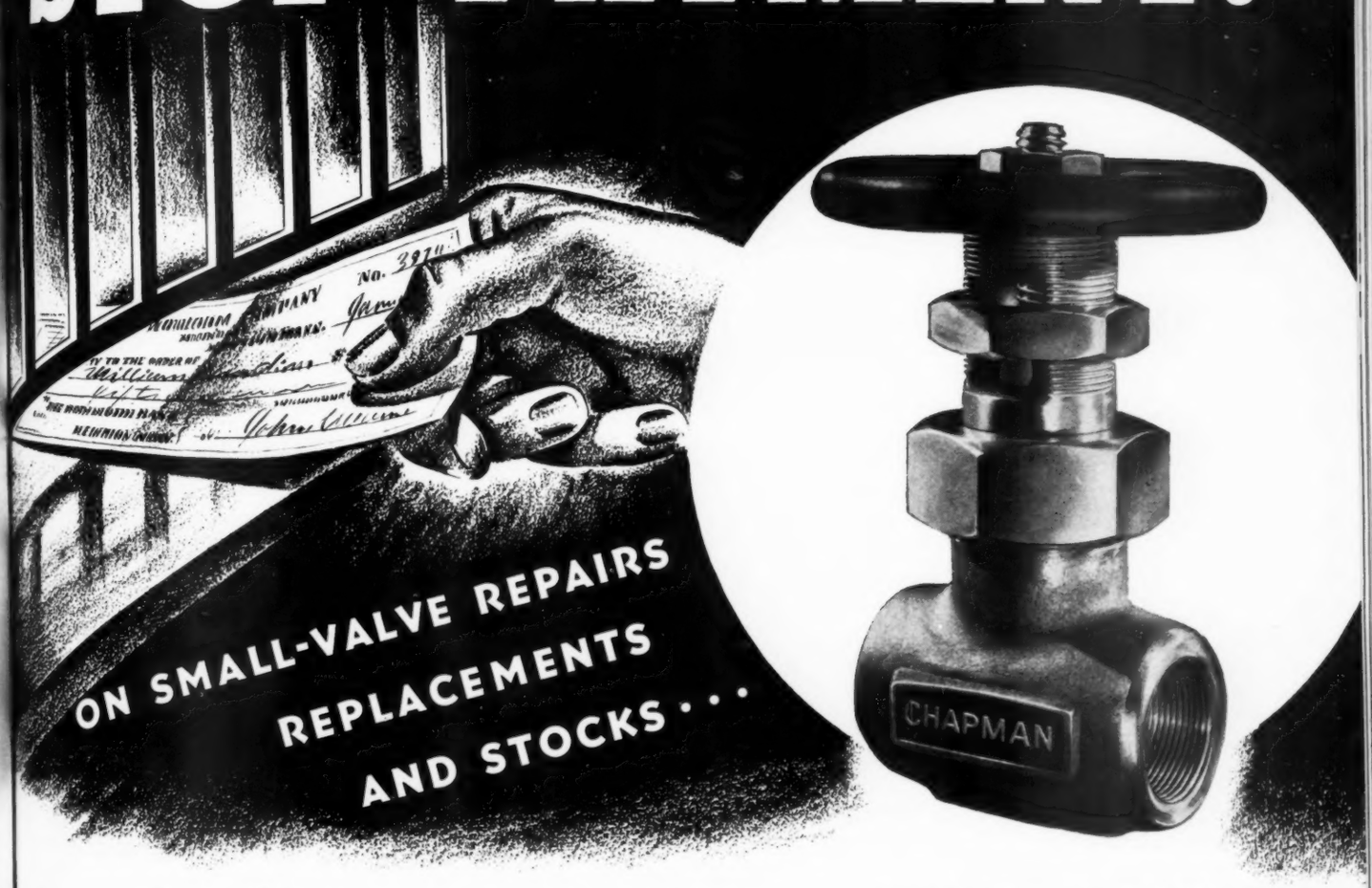

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This money-saving gate valve is available in eight sizes—and in special alloys for extreme conditions—at the factory and warehouses. Get in touch with the nearest Chapman office for prices and delivery date.

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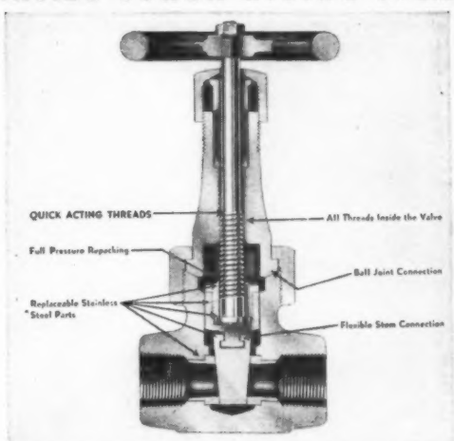
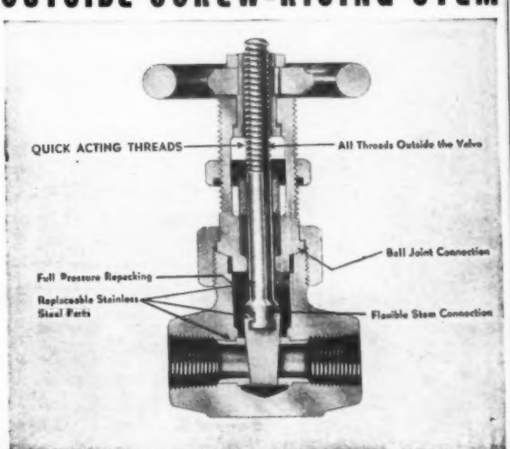


OUTSIDE SCREW-RISING STEM



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tion of generator voltage and as the generators have a drooping voltage characteristic any increase in motor torque causes the motor speed to drop off. The increased torque raises the load on the prime mover and the decreased speed lowers it so the resultant load on the prime mover is a function of the product of the torque and speed with d.c., while with a.c. it is a direct function of torque. This is illustrated by Curve No. 3.

The principal reasons why the industry did not adopt d-c. transmission for oil well drilling long ago are high first cost and the amount and complication of the equipment involved. An interesting attempt has been made to reduce the first cost by using a mechanical drive between the engines and the mud pumps, which require fairly constant power at constant speed. A number of rigs of this type are in successful operation but lack the flexibility of the all-electric transmission. The installation costs after the first set-up has been made are not excessive and rigging-up time is about the same as that required for a steam rig since all leads are properly tagged and can be connected up by one of the crew quickly and correctly. It is logical to assume that rigging-up will be simplified further by the use of more convenient connectors and multiple-conductor cables. Some operators now are cutting their heavy stiff main power cables in shorter lengths with lugs at each end and moving them from one location to another inside a joint of pipe. Although these improvements have no effect on the operating characteristics or drilling ability of the equipment, they do effect economies in d-c. drilling.

Compact, Economical Gas Booster Station

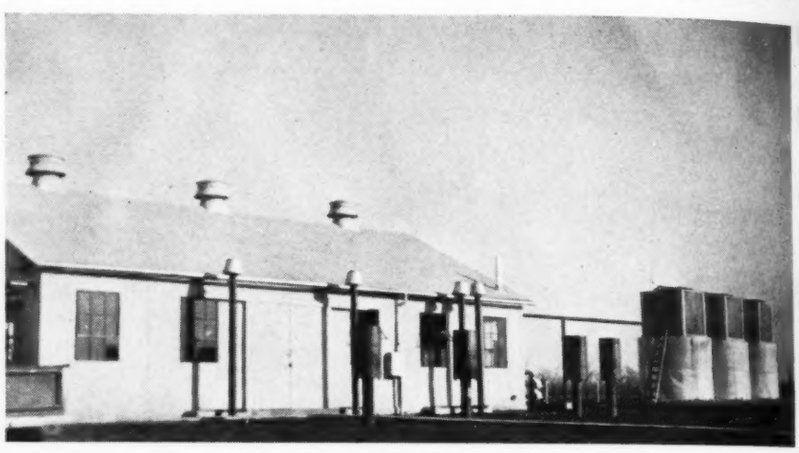
« By LEO H. TOWERS »

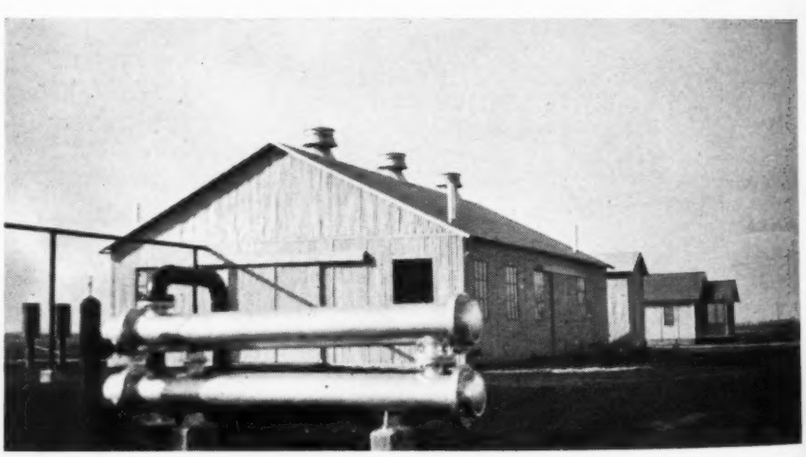
ANOTHER station was "put on the line" in the vast network of the the Cities Service Gas Company's gas-gathering system with the completion last month of their new Wellington Station. This station, two miles north and one mile west of the town of Wellington, Kansas, obtains its gas supply from the North Wellington Pool a mile west of the station site. Gas is boosted from the station to a point four miles to the east where connections have been made to the 20-in. and 10-in. main lines from Oklahoma and Wichita.

Although almost all equipment used in the station (including the station building) had been used previously the plant has the appearance of a new layout. It is a good example of a modern, small, economical booster station to serve the needs of a small field. From the field to the station the line is made up of 12-in. and 10-in. pipe. On the discharge side from the station to the main line 8-in. pipe is used. Suction and discharge lines are manifolded in front of the station house, with all lines buried, leaving only the gate valve wheels exposed. Under present operating conditions the gas enters the station at a pressure of 10 lb., and leaves at a discharge pressure of 100 pounds.

Three compressors were installed, with all equipment and piping arranged in a manner to allow for an additional three units should future demands make them necessary. Two units are 80-hp. Cooper-Bessemer single-cylinder engines; the other is a twin-cylinder Cooper-Bessemer 160-hp. engine. New heads were installed in the twin unit to increase slightly its capacity. The total capacity of the three units is 3,000,000 cu. ft. of gas daily.

The cooling system includes gas coolers on the discharge line, as well as engine and compressor cooling. Each unit has its own centrifugal water pump, belt-driven from the flywheel.





Upper photograph—Station house and cooling tower. Lower photograph—Front view of station showing the gas coolers in foreground, station building, office, and operator's cottage

Water is drawn from the supply tanks situated under the cooling towers, and through the gas coolers before circulating through the engine and compressor jackets. Two Worthington Western closed-type coolers are connected in series on the discharge line. Each cooler consists of a 13-in. diameter by 10-ft. jacket surrounding ¾-in. copper tubes, of which there are 105. After circulating through the compressors the water returns to the 3-unit cooling tower and into the supply tank, completing the cycle.

A 2-kw. Kohler light plant provides electricity for the station, toolhouse, and cottage lights. Starting air is supplied by a Fairbanks-Morse compressor.

Construction of the station was by the Cities Service Company's own crew under the supervision of Jack Boyer. Work started on October 29th and the station was put into operation December 18th.

SWABBING 3 to 15 times faster

... protecting the sand ... profits from oil gotten into the tanks quicker

WOULD INTEREST YOU, WOULDN'T IT?

The MISSION VALVELESS SWAB

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FALLS LIKE A PLUMMET

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SPLIT-RUBBER PRINCIPLE

Half the rubber rises above and clear of the stationary half, allowing direct, unrestricted fluid passage.

SAFER: Gas pressure will open split-rubber, permitting gas to by-pass, resuming its load without loss after gas has passed. No loose line over derrick floor to endanger crew.

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REGULAR TYPE SWAB
Average round trip . . . . . 2 hours
Used 32 sets of rubbers on 32 trips. Swabbed 64 hours and being unsuccessful, changed to Mission.

MISSION VALVELESS SWAB
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After 8 hours' constant swabbing, rubbers still in good condition and capable of many more hours' work.

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Fig. 2 (upper)—Drawworks, transmission, and engines in position. Starting engine is shown in the foreground

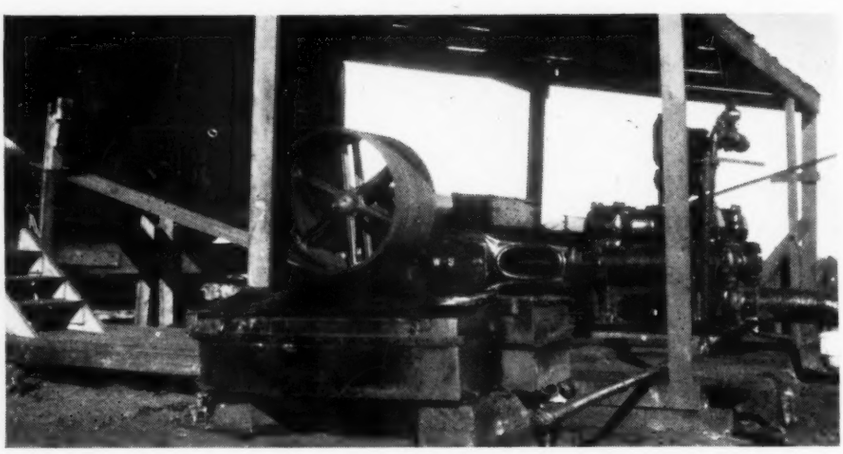

Fig. 3 (lower)—Slush pump in position showing V-belt drive

By
J. P. VAN VORST

●

Arrangement and design of engine-driven unit indicate means employed to reduce operating costs

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Compact Lay-out of Rotary

AN interesting drilling rig is in operation near Wickett, Texas, by the Eppenauer Drilling Company. The rig has a compact arrangement of hoisting gear, rotary drive, and cathead shaft, and transmission and gas engines for power, all mounted on a structural steel frame. The usual practice when using gascline or gas engines for driving a rotary rig capable of drilling from 8000 to 10000 ft. is to have a conventional 4-speed drawworks (either unitized or mounted on the derrick floor by the old-style method of head boards, jack posts, etc.), back of which is mounted a heavy reverse and direct clutch. Directly behind the clutch and reverse unit, and connected to it by chains or texrope drives, are the engines with the necessary clutches and shafts for driving either drawworks or slush pump or both, with either or both engines. This arrangement is heavy, cumbersome, requires a very solid foundation, and takes considerable time to erect properly.

With this particular model rig, which is capable of drilling 12000 ft. of 9-in. hole with 4-in. drill pipe, the drawworks, a 3-speed and reverse chain-

Fig. 1. Diagram of drilling rig arrangement

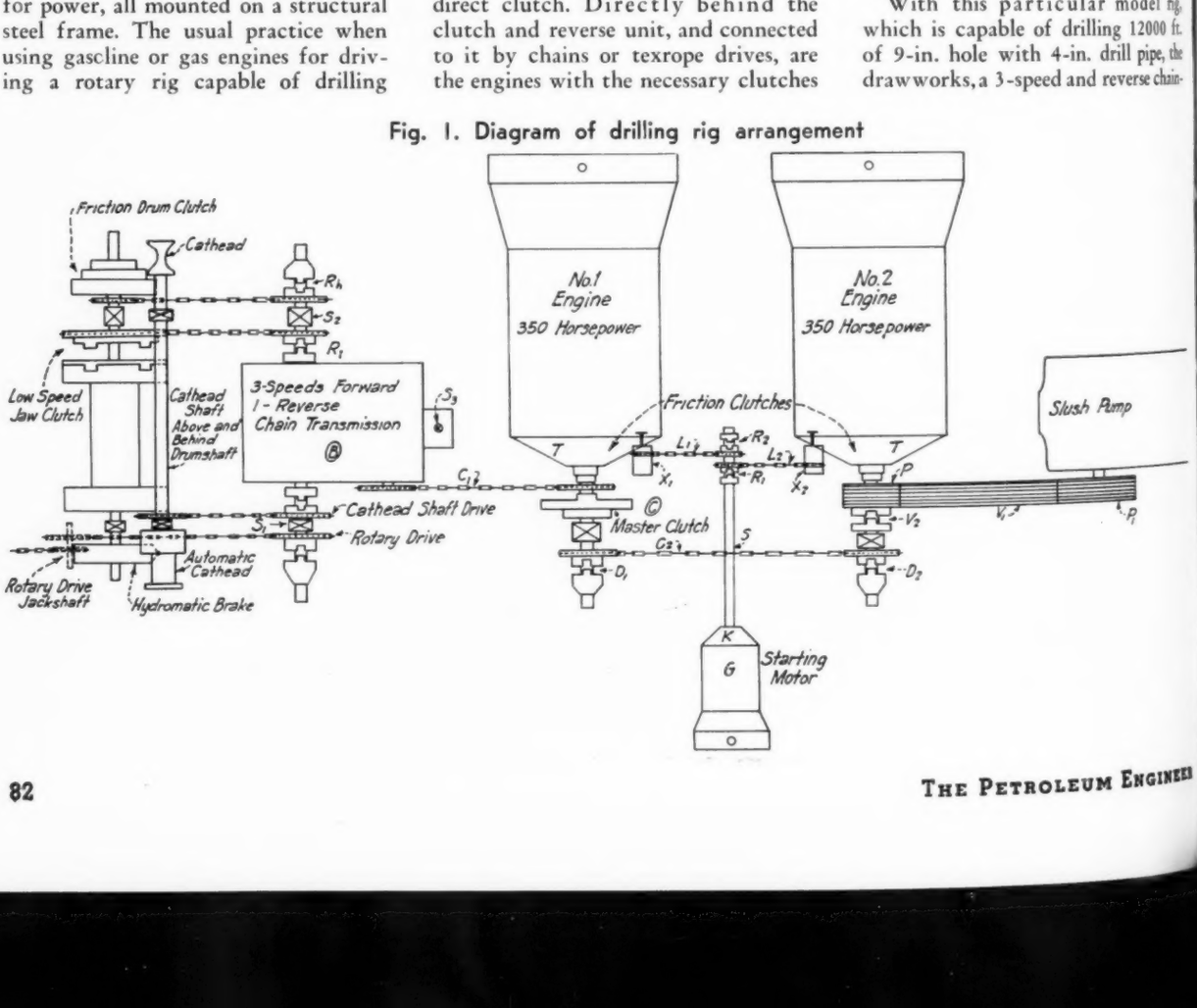


Fig. 4 (upper)—Derrick and unit with engines being skidded to a new location

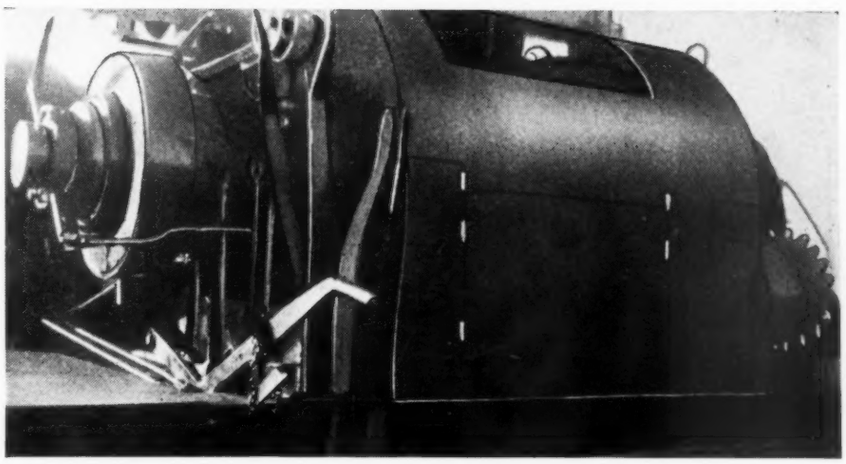


Fig. 5 (lower)—Showing the hoisting drum, central levers, engine throttle, central rotary drive sprocket, and high-speed Dodge friction clutch.

Rotary Rig for Deep Drilling

driven transmission, two 350-hp. 6-cylinder gas or gasoline engines with the necessary clutches, sprockets, and chains for either engine, or both, to drive drawworks or slush pump, or both, are all mounted on one horizontal steel frame, (See Fig. 2), and placed on a foundation of heavy timbers. The drawworks end is placed on the derrick floor similar to the usual unitized drawworks, a steel I-beam similar to the old-style head board is fitted to the top of the drawworks frame and securely turnbuckled to the sills under the derrick floor at the two derrick legs nearest the drawworks. A slush pump, 7¼ by 18 Wilson Snyder, (See Fig. 3), is placed on a separate foundation just to the rear and below the level of the No. 2 motor, and is driven by 18 V-belts. Tension of the V-belts is adjusted by an adjustable roller fitted to the frame of the engine.

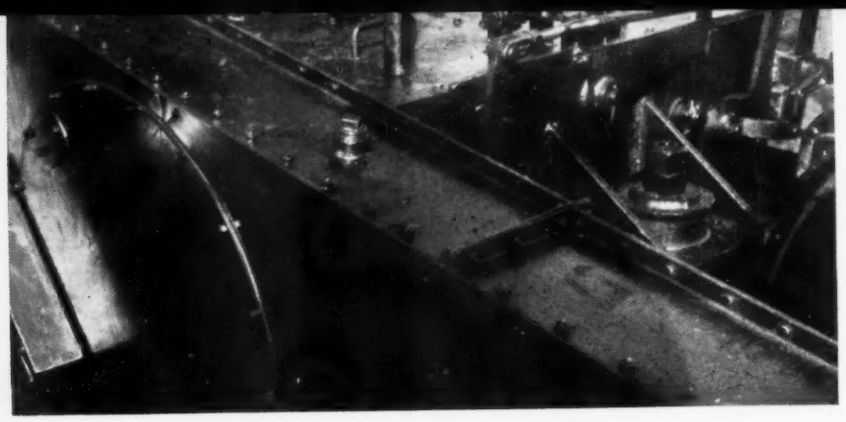
The weight of the unit, including engines, skids, transmission and drawworks, is 70,000 pounds. This unit recently was skidded onto the derrick floor and it, together with the derrick, skidded to the next location. When the foundation for the unit was prepared it was pulled back to its proper position. Fig. 4 shows the derrick and the unit with engines being skidded to location.

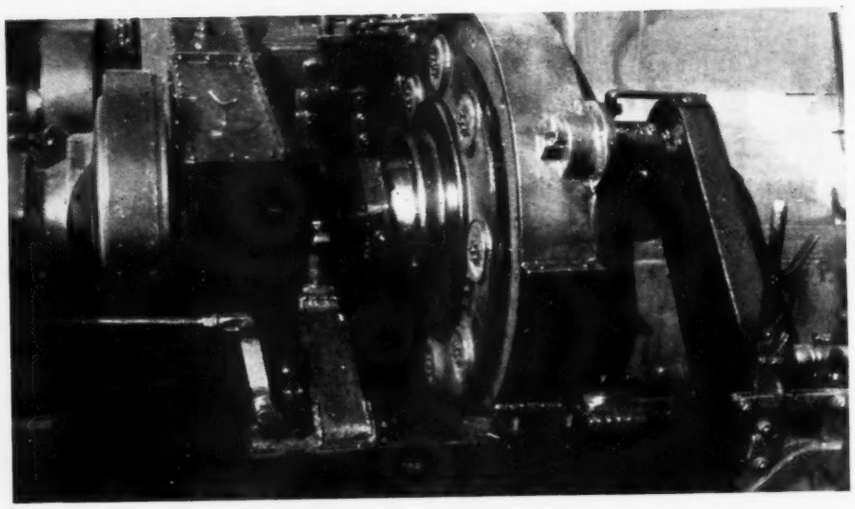
The plan of the arrangement of drawworks transmission, etc., is shown in the accompanying sketch, Fig. 1. The hoisting drum, with low-speed and high-speed clutches and hydromatic brake, is mounted on a 7-in. shaft equipped with roller bearings, shown in Fig. 5. The low-speed clutch is a 20-in. jaw clutch with the stationary half bolted to the drum end. The high-speed clutch is a Dodge friction clutch, shown at the extreme left in Fig. 5. Both clutches are controlled by jaw clutches, which are disengaged when the clutches are not in use, thus preventing unnecessary rotation of the sprockets. These are shown in the sketch Fig. 1, R_l and R_h. The 3-speed and reverse chain-drive transmission with drive to rotary cathead shaft and drum shaft is shown at B. The two-speed clutches on the drum shaft, together with the 3-speed transmission, makes six speeds ahead. This is shown in Fig. 6. With the type of jaw clutches used, single-step bevel undercut and the master clutch, reversing to disengage them is unnecessary.

The transmission consists of sprockets of the proper ratios connected with double chains of 2-in. pitch. Should a chain break it is an easy matter to replace it with minimum loss of time. The different speeds are engaged or disengaged by sliding jaw clutches splined to the secondary shaft into or out of the jaws in the sprockets. An interlocking mechanism prevents the engaging of more than one speed at a time. This transmission is capable of transmitting 700 horsepower. The transmission case is supported by the bearings of the output shaft and a third rubber-cushioned support mounted at the rear of the case. These supports are shown at S_1, S_2, and S_3 in Fig. 1. The master clutch is shown at C. This clutch is operated by the driller from his regular station on the derrick floor by means of pedals. Fig. 7 also shows the master clutch. Should this clutch fail it can be locked in driving position and the two engine clutches used instead.

When engaged it drives the transmission through chain C_1 in Fig. 1. The jaw clutches for chain C_2 are shown at D_1 and D_2. These are engaged when both engines are used to drive the drawworks or slush pump, or when No. 1 engine has to drive slush pump, or No. 2 engine has to drive the drawworks. The chains, C_1 and C_2, are covered by an oiltight case and run in an oilbath. Jaw clutch V_2 is engaged in order to drive the slush pump through V-belts V_1.

P and P_1 are the 18-grooved texrope pulleys for driving the slush pump.





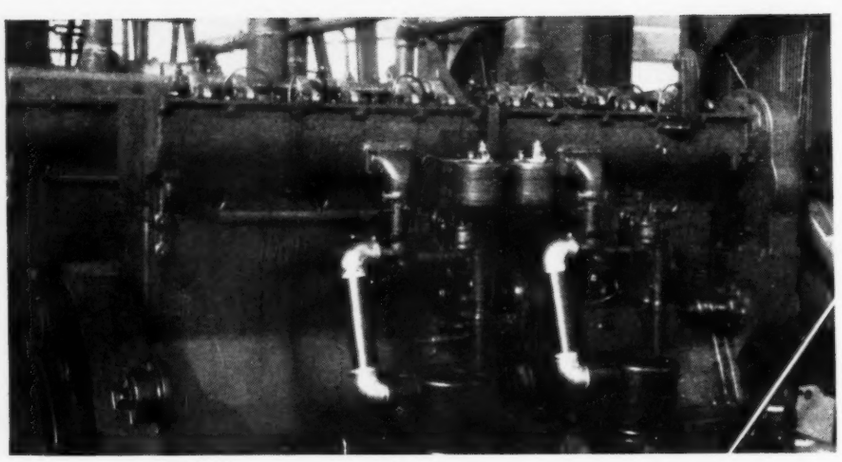


Fig. 6 (top)—Showing rear support of transmission and interlocking speed change mechanism

Fig. 7 (center)—Master clutch; special twin-disc engine clutch with rubber ring drive and Bendix drive for starting engine

Fig. 8 (lower)—Engines, showing overhead camshaft, carburetors, air filters, magnetos, governor, and camshaft chain drive housing

Each engine has a separate Twin-Disc friction clutch, shown in the sketch (Fig. 1) at T, and also in Fig. 7. The driving plate is driven from the flywheel by means of pins bolted to the latter. The opposite ends of the pins are attached to the center of the rubber rings, miniature tires filled with compressed air, which in turn are attached to the driving plate. This arrangement acts as a shock-absorbing drive and eliminates the necessity of a pilot bearing in the center of flywheel and flexible coupling between clutch and outboard bearing. The engines are cranked over and started by a 40-hp. gasoline motor shown at G in the sketch (Fig. 1) and in the foreground of Fig. 2. After starting the gasoline engine the clutch K is engaged and the shaft S rotates and drives through jaw clutch R_1 or R_2, the Bendix drive X_1 or X_2 through chains L_1 or L_2, which rotates the engine to be started.

The engines shown in Figs. 2 and 8 depart from the conventional gas or gasoline engine used for similar service in the oilfields in that the camshaft is overhead and is driven by a chain from the crankshaft. No push rods are used, the rocker arms from the camshaft acting directly upon the valve stems. The valves have a special spring seat, which is recessed and allows a cushion of oil to act between the adjustable plunger, fitted to end of rocker arm, and end of valve stem.

These engines are of 350-hp. each, 6-cylinder, 4-cycle, rated at 900 r.p.m., and have an 8½-in. bore and a 9-in. stroke.

They are equipped with two Ensign natural gas or gasoline carburetors, and are started and operated on natural gas. Ignition is supplied by two high-tension Bendix Scintilla magnetos with impulse couplings. Two spark plugs per cylinder are used.

Upper cylinder lubrication is supplied by two oilers using a special lubricant. Cooling water is circulated by a centrifugal water pump attached to the motor on a bracket near the left side (opposite from the magneto side), near the radiator and driven by V-belts from a pulley attached to an extension through the chain case of the magneto drive shaft. This makes adjustment, repairs to, or replacement of, the water pump a simple matter. Radiators with removable sections are used. Lubrication is force feed to the seven main bearings, camshaft, connecting rods, and rocker-arm bearings. The oil pump is fitted in the crankcase under the crankshaft and driven by a single chain from the crankshaft. Before reaching the bearings the oil is filtered by a fine wire screen filter having two screens and a by-pass valve set to allow the oil to go to the bearings should the screen be clogged. After passing the filter the oil is cooled by a Harrison oil cooler. The circulating water from the radiator to cylinder jackets is the oil-cooling medium. Two exhaust manifolds are used. They are water-cooled.

To date the rig and smaller units of the same make have made a good record for speed and low-cost drilling. They can be used in any territory. Their greatest economy is demonstrated in localities where water is scarce and the fuel cost high; for example, on wildcat locations in West Texas or New Mexico.

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Recent Developments in the Manufacture of Anti-Knock Gasoline

Expansion of automotive and aviation industries has resulted in the necessity for gasoline of high anti-knock quality — studies and progress made in providing superior motor fuel

By
R. FUSSTEIG

BOTH from an engineering and economic standpoint the automotive industry is dependent to a great degree upon the quality of automotive fuel. With the expansion of the automotive industry the construction of motor cars becomes more complicated, resulting in the impossibility of using straight-run gasolines because of their great detonating qualities. Detonation, more commonly termed fuel knock, is a rather elusive property of fuels that develops particularly at high pressures and results, first in noise and, if severe, in mechanical damage and overheating of the engine, as well as other difficulties.

In order to obtain fuels of anti-detonating, or anti-knock, qualities, technologists have been studying intensively all possible methods and sources of supply. This study has been accelerated more recently by the demand for fuel for high-compression supercharged aviation motors. Various schemes have been proposed for cracking heavy oils, particularly the conversion of straight-run gasoline and naphthas into high-octane gasolines because of their original unsuitability as motor fuel in modern cars. Progress in the art of cracking has established that gasolines cracked in the vapor phase have more resistance to knocking than those cracked in the liquid phase. This perception led to the use of the so-called recycle-process. In this process the gasoline vapors leaving the cracking unit are submitted to a high temperature in a reaction chamber. The cracking reaction in the vapor phase of the recycle-system causes the detonating hydrocarbons to be transformed into gasoline of high anti-knock qualities. In other words, the movement of the split hydrogen atoms during the cracking and recycle process depends to a large degree upon the reaction conditions.

The essential characteristics of the cracking process, however, lie in the fact that always there is formed along with the light hydrocarbons, other products resulting from the hydrogen atom split from the second part of the molecule combining to form rearranged groups of hydrocarbons, and as the crude oil contains approximately 14 percent of the available hydrogen, this second part of the split molecule is transformed into polymerized heavier hydrocarbons, such as tar and coke. These observations led to the development of what is known as the generical hydrogenation process; this sort of hydrogenation differs entirely from the simple hydrogenation process. By simple hydrogenation is meant solely the addition of hydrogen to the molecule without any derangement of basic construction. Destructive hydrogenation is a combination of simple hydrogenation and pyrolysis, the simple hydrogenation taking place after the rupture of the molecule; in other words, destructive hydrogenation is a combination of the cracking process and simple hydrogenation. In destructive hydrogenation the polymerization processes may be prevented so that only light products are made. The addition of hydrogen at the moment of the splitting of the molecules prevents the polymerization and condensation of the unsaturated hydrocarbons.

This new field became of importance to automotive engineers, for it presented the possibility not only of the production of hydrocarbons generically to increase the available supply, but also of controlling or altering the constitution and properties of the synthetic products, as well as hydrocarbons of natural origin, to obtain that type of molecular structure that best lends itself to the requirements of the automotive industry. This process consists briefly in pumping the charging stock, together with hydrogen compressed to between 3000 and 4000 lb. per sq. in., through heat exchangers and a heat coil into reaction vessels containing a highly-active sulphur-resistant catalyst. The oil and hydrogen flow through these reaction chambers where hydrogenation occurs, then back through the heat exchangers and coolers and into vessels that separate the gas from the liquid product. The hydrogenated oil is now ready for final distillation or finishing by regular refinery procedure.

This new art of increasing gasoline production is a highly complicated process, because chemical reactions that occur depend upon working conditions; that is to say, upon temperature, pressure, and time. Three characteristic reactions remain unaltered in direction, however, changing only in extent. The first of these reactions is a species of purification that has been called Ellis hydrocarbonization, and is defined as the tendency to eliminate from the liquid production of the reaction everything except hydrocarbons. The alien elements, sulphur, nitrogen, and oxygen, present in natural hydrocarbons and bitumens, are preferentially attacked by the hydrogen so vigorously that they leave the reaction zone as the corresponding gaseous hydrides. Thus the first and universal result of the hydrogenation process, as regards the character of the products obtained therefore may be said to be chemical purity. That is the reason that a hydrogenated oil is always a very near approach to a chemically pure hydrocarbon mixture.

The second characteristic reaction is that of stabilization. The hydrocarbons that emerge from the hydrogenation process are by the very nature of the process in all cases chemically stable to a marked degree. Stability is related to, but should not be confused with, chemical saturation or carbon to hydrogen ratio. From the engineer's standpoint stability is measured by actual resistance to chemical change in storage and in use, which is the character of stability meant here.

The third characteristic reaction is that of homogenizing, by which is meant the tendency to produce a mixture of a more homogenous nature than the raw material by the preferential reformation of the more complex molecules present.

These three characteristic effects of hydrogenation treatment, purification, stabilization, and homogenization, are

highly desirable and their attainment in itself would be of interest to the engineer as offering the promise of a generally higher level of quality for motor fuel and lubricating oils.

The effects referred to, however, are secondary rather than primary. The most important properties of motor fuels and lubricating oils are those derived from the chemical structure of the prevailing type of hydrocarbon present in the mixture. Petroleum products, such as gasoline and lubricating oil, are, of course, essentially hydrocarbons, but the range of molecular structures extends from the straight-chain paraffin-type on the one hand to the aromatic-type on the other, together with the almost infinite possibilities for modifications and combinations of the two types. Each basic type possesses recognized advantages both for fuel and lubricants. In general, the paraffinic types are advantageous for lubricating oils, while the naphthenic types are preferred for gasoline. In producing naphthenic gasolines the result is usually a less pure and less stable product than the paraffinic gasolines, but one that is decidedly superior in anti-knock tendency. It follows from the above that the possibilities the hydrogenation process offers for reforming the molecular structure of petroleum hydrocarbons along directed lines to obtain products of the so-called paraffinic or naphthenic type presents an opportunity to avoid these compromises.

Little attention has been directed toward the gases produced as by-product from cracking operations, and toward natural gas, these two gases being not only a prolific source of valuable anti-knock fuel, when properly processed, but they present also hydrocarbons rich in hydrogen, which are split during the cracking process and hence able to play an important part in the hydrogenation process. But before discussing this new matter, it is desirable to describe briefly the technology of the hydrogenation process.

In general, the hydrogenation process occurs in two stages: (1) Hydrogenation in the liquid phase of the heavy oils to produce a middle oil. The reactions occur at a temperature of approximately 450 deg. cent. and a pressure of 250 atmospheres. (2) Vapor-phase hydrogenation of the middle oil at a temperature of approximately 500-520 deg. cent. and a pressure of 250 atmospheres.

Separation of the process into stages serves to eliminate both of the aforementioned difficulties. In the liquid phase treatment, hydrogen concentrations of 70 percent can be satisfactorily maintained and the catalyst is not called upon to activate reactions producing light oils; in the vapor phase treatment, a hydrogen concentration of more than 85 percent can be readily maintained, and the dehydrogenation and polymerization of the reaction products are thus prevented. The catalysts used for the liquid-phase hydrogenation depend somewhat upon the nature of the raw materials and usually are added in admixture with the oil. For the vapor-phase hydrogenation the catalyst is suspended inside the converter, and the selection is based upon the nature of the final product desired. By careful control of temperature, pressure, catalyst, and time of reaction, it is possible to produce light hydrocarbons ranging from one that is completely aromatic to one essentially paraffinic in nature.

The recent development of hydrogenation processes has led to the observation that olefinic gases could be transformed into liquid hydrocarbons when submitting them to proper conditions. In the hydrogenation process the split unsaturated hydrocarbons are enriched with hydrogen, while in the above-mentioned case the olefinic gases are enriched in their free linkages with the same hydrocarbons; in other words, a polymerization of the same olefinic molecules takes place. Polymerization may be defined as a process during which two or more molecules of a substance are united to form a larger molecule, the latter being called a "polymer." The word "polymerization" has been known for many years. The first theory was proposed when technologists were studying the mechanism of refining with sulphuric acid hydrocarbon oils containing unsaturated hydrocarbons, viz., that sulphuric acid forms first an acid ester or alkyl sulphuric acid by addition; this addition product subsequently reacts with another molecule of the olefin to form the polymer. The sulphuric acid is liberated, and theoretically may go through many cycles. The second theory is called the partial-valence theory. According to this theory the double-linked carbon atoms have partial valences or "residues of free affinity." The further assumption is made that the molecules contain a mobile or unstable hydrogen atom that shifts from one molecule to the other, thus permitting polymerization. According to either of the above theories, two unlike molecules also may react, thus explaining the formation of all the higher polymers.

The above characterizes in general, from a broad chemical viewpoint, the process of polymerizing light hydrocarbons. Opinions regarding the reaction mechanism involved in the conversion of specific constituent are divergent. From the standpoint of equipment design, theoretical consideration of the kinetics of the reaction are of importance. Polymerization generally is assumed to be a bi-molecular or second-order reaction. The reaction velocity constant, k, may be expressed by the equation: $k = \frac{x}{at\,(a - x)}$ where,

t = the reaction time
a = the reaction at the beginning of the reaction (t = o), and
x = the part of the original reactant that is converted in the time t.

A consistent correlation of data will establish the values of the reaction-velocity constant as a function of the reaction temperature of any constituent. Correct and consistent reaction velocity data are the prime requisite for the design of equipment of this type.

The equipment for carrying out the polymerization process is similar in appearance, operation, and instrumentation to cracking still equipment. Treating of the distillate is no different from treating of gaseous hydrocarbons. The most easily polymerizable gases are formed in the vapor-phase cracking of hydrocarbon oils. Such gas is now handled in two ways: (1) the compressed gas is charged as compressed gas to the polymerization coil; (2) a major portion of the residue gas is recovered as stabilizer overhead in a liquid state and in this form is pumped into the polymerization coil.

When using the first method, the above-mentioned gas is compressed to a pressure of 600-800 lb. and heated to 900-1000 deg. fahr. in a special pipe coil heater. The gas is then soaked in a reaction chamber, which generally is in the form of a coil. This coil is cooled, in order to absorb the exothermic heat of reaction, by injection of either cold gas or oil. The reaction is checked at approximately 70 percent conversion, necessitating a recirculation ratio of about 1 to 5. Following the polymerization process the polymer is fractionated, and the liquid product when stabilized gives a yield of gasoline of approximately four gal. per 1000 cu. feet. This polymer gasoline contains approximately 25 percent aromatic hydrocarbons, is highly volatile, and has an octane value, by the ASTM method, of about 80, and a blending value of about 95. In order to produce more than 25 percent aromatic hydrocarbons, it is necessary to operate under other temperature-pressure conditions.

The second polymerization process mentioned consists in the elimination of the lower-molecular saturated hydrocarbons, CH_4 and C_2H_6, from the olefins as far as is practical to con-

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centrate the active olefins. This process consists in absorbing the higher-molecular hydrocarbons of the cracked gas and recovering them from the absorbing medium under high pressure as a liquid, or in separating and fractionating directly under pressure and requiring compression of the cracked gas and fractionation of the condensed portion. When using this method, the amount of ethylene in the charging stock is relatively small, since it would require very high pressures or low temperatures to get it in the liquid phase; however, the gasoline yield is but slightly reduced, because ethylene polymerizes too far and forms tar if the reaction is carried out at the proper temperature for the propylene-butylene reaction. The temperatures and pressures employed are within the same ranges as given in the case of the gas-charging operation. In other words, these two methods are not able to produce a gasoline of more than 25 percent aromatic hydrocarbons. As mentioned, to increase the volume of aromatics, other methods must be used. The gas must be submitted to a pyrolysis at a high temperature and then polymerization reaction of the aromatic hydrocarbons seem to be ideal. Of course, a low pressure must be used in this instance.

In earlier literature on pyrolysis of hydrocarbons, the opinion is expressed that aromatics are formed only at extremely high temperatures, temperatures considerably above those to be disclosed as proper and sufficient in the recent processes. Free-energy relationships, however, indicate that aromatic hydrocarbons are formed from olefins of certain molecular weight at as low temperature as 800 deg. fahrenheit. The older literature referred to mentioned temperature of the order of 1500-2000 deg. fahrenheit. When polymerizing at comparatively low temperatures and high pressure, the simple junction of molecules with the least disturbance of the existing carbon-to-carbon and carbon-to-hydrogen linkages seems to prevail, whereas at higher temperatures a complete rearrangement seems to take place leading to the formation of cyclic compounds. These polymerization processes, however, pass in quite other ways. According to the writer's opinion, the hydrocarbons are split in the first phase during the process into an active carbon and hydrogen. Of course, this active carbon cannot be separated in this form, because it exists only a very short time in this potential state. In other words, this potential state may be considered as a carbon atom in a nascent state. According to the writer's opinion, the hydrocarbons are split during the cracking or polymerization into two parts of carbons. The first form of the carbon is able to bind four hydrogens, whereas the second part binds only two hydrogens. In the polymerization process only the second part of carbon plays a very important part, because the $=CH_2$-molecules obtained in the process can be submitted to the polymerization process. Thus it is seen that the yield of the polymerized gasoline depends upon the amount of the produced $=CH_2$-molecules. Temperature and pressure here play a very important part. When using a high temperature, the free linkages will be directed to the middle of six $=CH_2$-molecules, causing them to be bound into aromatic hydrocarbons. One may conclude from this theory that hydrogenation, cracking, and polymerization have in their first phase the splitting up into carbon and hydrogen, and that the formation of the four groups of hydrocarbons—namely, unsaturated, aromatic, and paraffinic hydrocarbons—is the result of different reaction movements of the molecule $=CH_2$, whose composition varies as a function of temperature, pressure, and time.

Not all hydrocarbons, however, can be easily split into the carbon of two linkages. In this case, a very small yield of $=CH_2$-molecules would occur. The saturated hydrocarbons produce, during the cracking or polymerization, a very little part of carbons with two linkages, the major part supplying the carbon of four active linkages, this carbon being able to bind other carbon atoms of the same quality. Thus, the precipitation of coke occurs in this case; therefore, many processes eliminate the saturated hydrocarbons before submitting the gases to the polymerization process. The writer's investigations have established that it is possible to transform the carbon with four active linkages into carbon with two active linkages. For this purpose the writer has also constructed a special system; but before discussing this system it is desirable to discuss characteristics of the saturated gaseous hydrocarbons, which, due to their carbon content, caused a great deal of trouble in the polymerization process.

The existence of large quantities of natural gas has been the impelling factor behind the desire to transform it into gasoline hydrocarbons. During past years only a fraction of the natural gas produced has been used for industrial and domestic purposes, whereas a vast volume, amounting to many millions of cu. ft. per day, has been irretrievably lost through the residue gas vents of the many natural gasoline plants. The recent development of several polymerization processes has unfolded an entirely new vista, insofar as the increased and profitable utilization of natural gas resources is concerned.

As mentioned, the polymerization process consists of two general reactions: (1) the splitting up of hydrocarbons into carbon and hydrogen, and (2) the formation of the $=CH_2$-molecules with two active linkages, these free linkages being able to be transformed into olefinic or aromatic hydrocarbons. Gases with definite characteristics may be submitted easily to this process, because the formation of the $=CH_2$-molecules easily occurs here; however, the more saturated hydrocarbons the gas contains, the greater the difficulties that may be encountered in the polymerization process. The reason for this is that a great deal of the split carbon presents an element of four free linkages, having in consequence the tendency to form tar. On the other hand the split hydrogen from the saturates prevents the formation of olefinic and aromatic hydrocarbons; hence, the recent polymerization processes are forced to

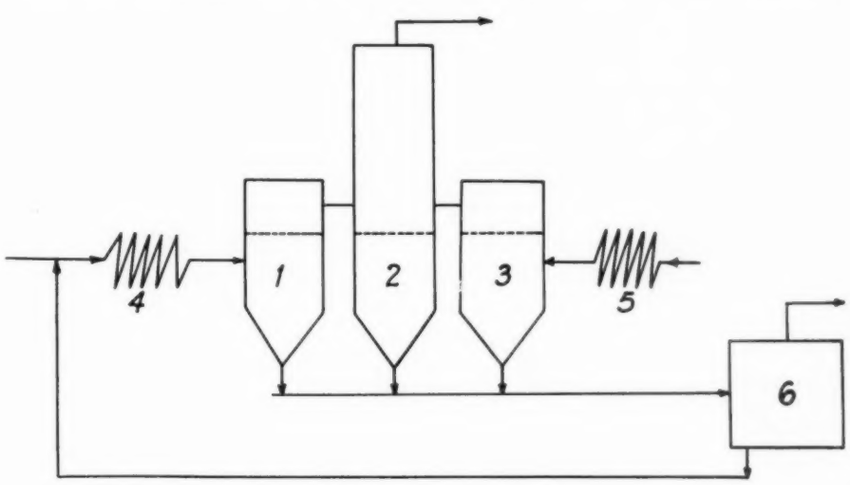


Fig. 1

eliminate the saturates from the olefinic gases. Viewing the polymerization process of natural gas in the light of the above we are forced to the conclusion that it is very difficult to split the saturated hydrocarbons of the methane series into hydrocarbons of olefinic character. In recent polymerization processes the natural gas is subjected to cracking in order to yield a high content of the olefinic gases; however, the cracking is carried out in such a way that small quantities of gasoline and fuel oils are produced, along with great quantities of gas and coke, which in many cases are difficult to dispose of. The result is that the new polymerization processes are unable to transform carbon with four free active linkages into carbon with two free active linkages; another method, therefore, must be chosen for this purpose.

The proper polymerization process for hydrocarbons of the methane series should be carried out in such a manner that the formation of carbon with two free active linkages results in the liberation of the split hydrogen atoms at the same time:

$$CH_4 \longrightarrow CH_2 + 2H$$
$$C_2H_6 \longrightarrow 2CH_2 + 2H$$
$$C_3H_8 \longrightarrow 3CH_2 + 3H$$
$$C_4H_{10} \longrightarrow 4CH_2 + 4H$$

In other words, the natural gas first must be dehydrated in such a way that these hydrogen atoms will be taken up by the hydrocarbons poor in hydrogen. Investigations have established that the hydrogenation between the split molecules of methane and the split higher-molecular hydrocarbons can be carried out easily if the proper catalyst, pressure, and temperature are used. In this instance, not only the polymerization of the split groups of methane and the hydrogenation of the split hydrocarbons will be produced; but the chemical reaction between such split groups of methane and the other split hydrocarbons will take place, procuring, in consequence, an increase in the gasoline yield. Of course, the catalyst plays a very important part in this process. As catalyst, a mixture of manganese, molybdenum, and tungsten sulphides has been used in this process. Methane has been heated to a temperature of about 720 deg. cent. before entering the reaction chamber, and the charging stock to 475-485 deg. cent., before being submitted to the hydrogenation process in the reaction chamber. For both methane and the charging stock a pressure of approximately 200 atmospheres has been employed.

A system embodying the principles mentioned has been designed by the writer. A somewhat simplified flow diagram of this process is shown in Fig. 1. The crude charge is pumped through exchangers (not shown in the figure) and delivered to the tube still 4, being thus preheated to a temperature of 475-485 deg. centigrade. The charge flows from the tube still 4, into the reaction chamber 1, where a partial rupture of molecules takes place. At the same time methane is compressed and charged as compressed gas to the tube still 5, being preheated to a temperature of approximately 720 deg. centrigrade. The preheated methane flows then into the reaction chamber 3, where the rupture into new groups and hydrogen takes place. Both the split molecules of the crude and those of methane pass into reaction chamber 2, where the polymerization and the hydrogenation process occur. The process is accelerated by the catalyst previously mentioned, which is placed on special decks inside of each reaction chamber. The gasoline vapors and gas produced flow upward through the top of the reaction chamber, being then delivered into a fractionation tower (not shown in the figure) where pressure is reduced to atmospheric. The final fuel oil residuum from the base of the reaction chambers 1, 2, 3 passes through the crude oil exchangers to the fractionation tower 6, where a fractionation takes place and the recycle stock is conducted to the tube still 4, to pass again through the furnace with the preheated fresh charging stock. This process accomplishes two things, each of which is advantageous during the process when they are submitted separately to the cracking, hydrogenation, and polymerization process. The destructive hydrogenation is used to prevent the separation of tar and coke. The addition of hydrogen is easily accomplished and is economical. The common splitting process of the higher-molecular hydrocarbons and natural gas permits the higher-molecular hydrocarbons to be hydrogenated with the aid of the split hydrogen from the natural gas. On the other hand, the removal of these hydrogens from the sphere of the split natural gas causes a better polymerization of the $=CH_2$-molecules. In other words, the removal of these hydrogens permits the easy transformation of carbon with four active linkages into the carbon of two active linkages, resulting in less coke and tar being formed.

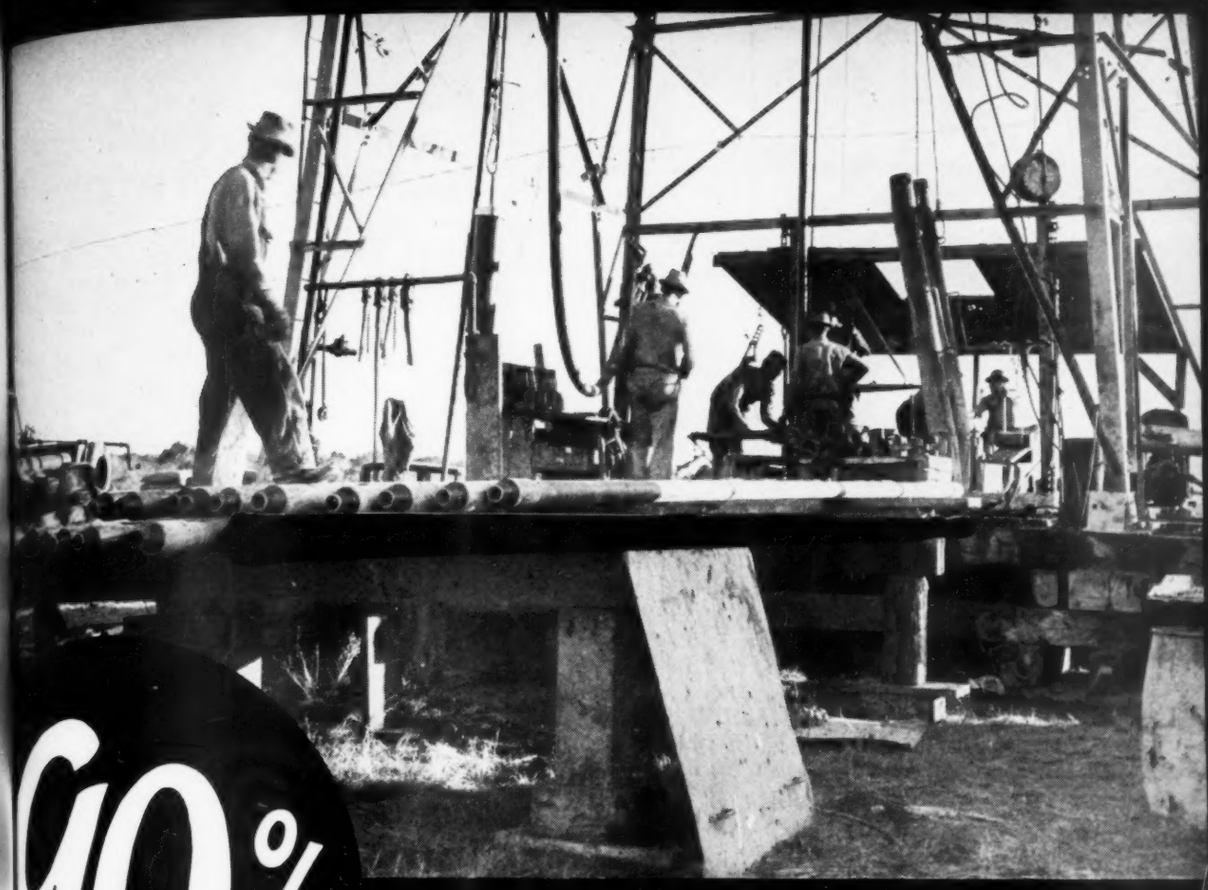
This process produces a high yield of gasoline that is characterized by a high octane rating, high volatility, and low sulphur content. Aromatics and olefins are predominant in this process. In addition to these characteristics, the construction of this system is simple, and the process is economical in operation.

Progress of Engineering Knowledge in the Electrical Industry

AN education in engineering consists chiefly in a grasp of the quantitative relationship of things—knowing how much of what to put together to achieve any desired result. The engineer's first instinct, therefore, is to visualize his objective, to make a model or prepare a sketch. As the problems of industry have become steadily more complex, it is necessary to include more and more things in one's picture, so that every engineer is on the lookout for new shorthand methods of picturing or representing relationships. Physicists have passed the stage of desiring mechanical models of their atoms, and are satisfied with the purely abstract concepts of mathematics. They object, in fact, to their imaginings being hampered by seeing the color, the materials, and the other gross characteristics of any fleshly model, says P. L. Alger of the Engineering General Department, General Electric Company, in reviewing the progress of engineering knowledge during 1936.

Thus, the avenue of progress in education in design engineering recently has been along the line of making mathematics a more familiar friend of the engineer, by setting before the student a mathematical relation and comparing it successively with several physical interpretations in electrical, hydraulic, mechanical, or other fields. By so learning to see the mathematical skeleton of each phenomenon he meets, the student can appreciate analogies and apply knowledge gained in one field to all other fields. These educational ideas have been practically worked out in a recently published book on engineering mathematics, which includes material now given to students in the advanced engineering course of the General Electric Company.

For the more advanced or complicated engineering problems of networks, or systems with many degrees of freedom, the methods of Tensor Analysis offer interesting possibilities. For such problems, a single Tensor equation is sufficient to present the complete and most generalized formulation, and is entirely independent of the particular point of view, co-ordinate axes, or terminals selected.



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Depletion Deductions Allowable on Income Tax Returns

By GEORGE S. ATKINSON

IN connection with income tax returns, the taxpayer is primarily interested in two things: (1) What should be included in gross income? and (2) What deductions should be taken?

Oil men are, of course, vitally interested in the matter of income taxes and are especially interested in the matter of oil accounting from an income tax standpoint. One of the most contested questions today, as regards an oil operator's income tax, is that of depletion and many are in litigation with the Government because of an incomplete knowledge or understanding of the question.

Depletion, as is known, means a deduction authorized by law for the gradual diminution of natural resources. It differs from depreciation in that it is a gradual using up of natural resources, whereas depreciation is the gradual wearing out of artificial assets made by man, such as machinery, equipment, etc. Assets subject to depreciation may be replaced by man but assets and reserves subject to depletion may not be replaced by the hand of man.

The Revenue Acts of 1918, 1921, and 1924 each provided, in the case of oil and gas wells, for the deduction of a reasonable allowance for depletion of the oil reserves and for depreciation of the equipment on oil properties according to the peculiar conditions in each instance, and each of these revenue acts provided that in the case of such oil and gas wells discovered by the taxpayer on or after March 1, 1913, (the property being unproven as oil-producing property prior to discovery by the taxpayer) if the fair market value of such property became disproportionate to the cost due to the discovery of such oil, the depletion deduction could be taken on the basis of the fair market value of the property at the date oil was discovered thereon, or within 30 days after such date, on the basis of the number of barrels of oil removed from the ground.

In other words, if a man purchased an oil and gas lease in wildcat territory in 1918 for a nominal consideration, and thereafter in 1918 he drilled thereon an oil well that was a producer and thereby proved such territory, or, in the language of the statute, discovered oil, then that man would be entitled under the acts mentioned above to appraise the property and estimate the number of barrels in the oil reserves, thereby arriving at a fair market value of each barrel of oil in the ground; and with the removal of each barrel of oil, he would be entitled to deduct from his gross income the proper amount on this basis, which is called the "per unit basis", for depletion purposes.

Under these revenue acts it readily can be seen that it was necessary to estimate the number of barrels of oil in the ground on the basic date and also to appraise the property in order to arrive at this fair market value on the date of discovery, or within 30 days thereafter.

Discovery depletion was found difficult of correct determination for two reasons: (1) It was extremely difficult to determine the number of barrels of oil in the ground, and (2) it was difficult to determine the correct fair market value of oil and gas reserves. Realizing this difficulty, so obvious because of much litigation on this question under these three revenue acts, Congress in the Revenue Act of 1926 provided for the first time for depletion in the case of oil and gas wells of 27½ per centum of the gross income from the property; such allowance not to exceed 50 per centum of the net income of the taxpayer (computed without allowance for depletion) from the property.

The Revenue Acts of 1928, 1932, 1934, and 1936 all provide for the deduction of the 27½ per centum depletion in the case of oil and gas wells.

This 27½ per centum depletion is in lieu of discovery depletion and it is also in lieu of cost depletion. Under the Revenue Acts of 1926, 1928, 1932, 1934, and 1936, cost depletion may be claimed if it is greater than 27½ per centum of the gross income from the property not exceeding 50 per centum of the net income from the property; however, if depletion is taken on the basis of cost, an estimate of oil reserves must be made.

In the case of Burnet v. Harmel, involving the Act of 1924, the Supreme Court of the United States on Novem-

The Author

GEORGE S. ATKINSON

George S. Atkinson, attorney, of Dallas, Texas, has written this article exclusively for *The Petroleum Engineer*. A native of Kentucky, he was graduated from Vanderbilt University with an LLB. degree and soon thereafter entered the world war as a lieutenant of Marines. After the war he came to Dallas to practice law. From the beginning he has confined himself to income tax, inheritance tax, and estate tax matters, to the exclusion of all other forms of litigation. He has handled successfully for taxpayers, a great many cases involving income tax matters of oil operators and oil companies, a large percent of which cases has involved the vexing question of depletion allowance on income tax returns. He is considered an authority on income taxes and it is believed that this article will be interesting and helpful to our readers.

ber 7, 1932, held that bonus and royalties paid to a fee owner lessor under an oil and gas lease in the State of Texas, constituted "income" of the lessor and that they were taxable as such and that they were not taxable as "capital gains."

In the case of Murphy Oil Company v. Burnet, involving the Act of 1918, the Supreme Court of the United States on December 5, 1932, held that when the execution of an oil and gas lease is followed by production of oil, bonus and royalties paid to lessor both involve at least some return of capital investment in oil in the ground for which depletion allowances had to be made.

In the case of Palmer v. Bender, involving the Act of 1921, the Supreme Court of the United States on January 9, 1933, held that where a taxpayer sold and assigned a producing oil and gas lease in the State of Louisiana for a stated cash consideration, a future payment to be made out of a portion of the oil produced and saved, and an additional excess royalty, he is entitled to depletion on the cash, the "oil payments," and the royalty. The Court stated the principle to be that if the taxpayer had a right to share in the oil produced, he had an "economic interest" in the oil in place; that a bonus was a return pro tanto of the taxpayer's capital investment in the oil in anticipation of its extraction resulting in a corresponding diminution in the unit depletion allowance upon the royalty oil as produced.

In the case of Comar Oil Company v. Burnet, involving the Act of 1921, the U. S. Circuit Court of Appeals for the Eighth Circuit held that the Comar Oil Company, the assignee of oil and gas leases for stated cash considerations and sums payable out of portions of the oil and gas if, as, and when produced, was liable for income tax on the proceeds of oil runs that were paid over to the assignors of the oil and gas leases. Application for review by the Supreme Court was denied.

This case is the leading authority for the position taken by the Bureau of Internal Revenue at the present time, that so-called "oil payments" constitute income of an operator owner even though they are in fact paid over to his assignor direct by the pipe line company.

In the case of Herring v. Commissioner, involving the Act of 1926, the Supreme Court of the United States on December 3, 1934, held that a fee owner was entitled to 27½ per centum depletion on bonus received on the execution of an oil and gas lease and that the existence of an oil well was not necessary prerequisite to depletion.

In the case of Commissioner v. Fleming, involving the Act of 1928, the U. S. Circuit Court of Appeals for the Fifth Circuit on March 7, 1936, held that a taxpayer who had sold oil and gas leases for cash and oil payments if, as, and when oil should be produced, was entitled to depletion of 27½ per centum on the oil payments but that he was not entitled to depletion on the initial cash payments.

The court made a clear distinction in affirming the decision of the Board of Tax Appeals in the Fleming case between the facts in the Fleming case and the facts in the case of Palmer v. Bender, in that in the case of Palmer v. Bender an overriding royalty was retained; whereas in the Fleming case there was no overriding royalty retained. The Board and the Court each held that, to the extent of the oil payments to be received by the assignor, he had retained an economic interest in the properties entitling him to depletion of 27½ per centum on the oil payments. In denying depletion on the cash payments the Court said in part:

"In Palmer v. Bender, however, the transferor reserved an additional royalty, and so was in reality a sub-lessor and the cash paid him could more readily be treated as a bonus on advance royalty. We think the Board rightly held as to the transactions here in question that part of the income arose from a sale of a capital asset and was not subject to a depletion allowance, and that part of it arose from the operation of the oil wells and was so subject. . . . The thing sold for the cash consideration was the lease and all the oil except that so reserved. . . . We believe that the Board has correctly held that in such sales of interests in oil leases a money payment unconnected with production of oil is to be dealt with as representing a conversion of capital by sale, but that 'oil payments' where no personal obligation is assumed by the purchaser are to have the benefit of the statutory depletion allowance."

In the Fleming Case, the U. S. Circuit Court of Appeals was unanimous in the decision allowing depletion on the oil payments; but the Court was divided two to one on the question of denying depletion on the initial cash payments, one member of the Court writing a dissenting opinion on the ground that the taxpayer also was entitled to depletion on the initial cash payments that he claimed in cross petition.

A short time ago the U. S. District Court for the Northern District of Texas, in the case of Perkins v. Thomas, held that Perkins was subject to income tax on oil payments received from oil leases that he purchased, even though these oil payments were paid over direct by the pipe line company to his assignor, following the case of Comar Oil Company v. Burnet. On December 18, 1936, the United States Circuit Court of Appeals for the Fifth Circuit reversed the decision of the District Court, holding that under the principles laid down in the Fleming case Perkins was not subject to income tax on the oil payments in question.

The Fleming case has been followed by the United States Circuit Court for this, the Fifth Circuit, in allowing depletion on oil payments in the case of Commissioner v. Williams and Commissioner v. Jones, and by the Ninth Circuit in the case of Commissioner v. Elliott Petroleum Corporation.

In none of these four cases did the Commissioner petition the Supreme Court for review and yet to date, the Commissioner has non-acquiesced in these decisions and is not following them.

This leaves this question of depletion in a very unsatisfactory condition to say the least, and it will continue to be a bothersome question until some one gets it to the United States Supreme Court for final settlement.

Crane Packing Opens New Houston Warehouse

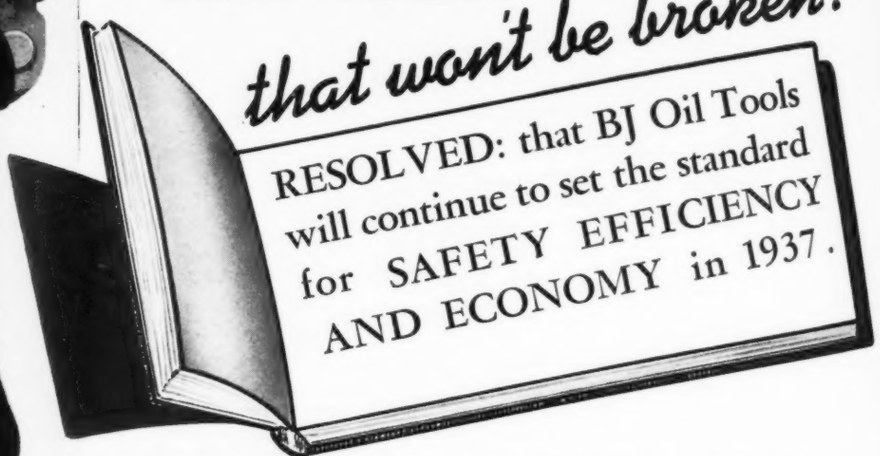
Due to an expansion program, the Crane Packing Company, Chicago, Illinois, have moved their Houston, Texas, office from 911 Electric Building to 1303 Capitol Street, where they have established a new factory branch and warehouse. A complete stock of "John Crane" packing is now being carried in Houston.

This move to larger quarters has been carried out under the direction of Roy Blackbird, Crane Packing Company manager in the southwest territory and who will be in charge of the new branch warehouse.

Silver-Lead Oxide Contacts

Silver-lead oxide contacts now are made up from powders and are essentially a mixture of silver and lead oxide with a little molybdenum added to increase the resistance to wear. They are pressed to the desired shape and then sintered to a red heat, producing a tip comparatively free from sticking while still retaining high electrical conductivity.

Resolutions AND TOOLS that won't be broken!



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. . . which are made from a single piece of steel, with large, convenient "eyes" at top and bottom. The BJ Perfection Bend fits under the elevator trunnions and not only makes handling easier, but also brings the lift directly upward under the collar or coupling. Made in diameters from 1¼" to 2¾" and lengths from 36" to 120" – with single handles, double handles, or plain.

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. . . the one completely safe elevator for setting any string of casing. The slips can be set by hand at any desired point, or will set automatically when the coupling is reached. Slips can be locked in set position, but are easily released, and will not stick or jam on the pipe. For handling all casing sizes from 2⅜" to 20" O. D.

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Safe-Efficient-Economical DRILLING TOOLS

By
H. LIGGETT GRAY*

Systematic, standardized methods of cleaning processing equipment insures the maintenance of such equipment at its highest efficiency

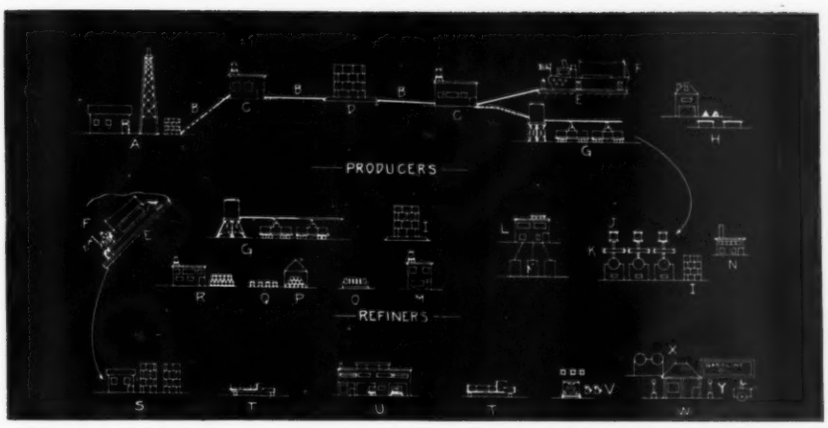


Fig. 1. Cleaning diagram of the oil industry:

(A) Wells and drilling engines. (B) Pipe lines. (C) Pumping stations. (D) Tank farms. (E) Docks. (F) Tank steamers. (G) Tank cars. (H) Salvage department. (I) Refinery storage. (J) Oil coolers. (K) Heat exchangers. (L) Tail house. (M) Test laboratory. (N) Power plant. (O) Filter presses. (P) Barrel house. (Q) Drum washing. (R) Can Department. (S) Distributing station tanks. (T) Truck washing. (U) Truck overhaul and painting. (V) Service cans. (W) Auto filling stations. (X) Auto filling station storage tanks.

—(Copyright, Oakite Products, Inc.)

Engineered Methods for Cleaning Equipment » »

SOME years ago when gasoline had no octane rating and the S. A. E. motor oil ratings were not yet in use, cleaning was just a misfit job to be handed along to some unfortunate individuals. There were no standardized materials or methods, no sources of practical and reliable information on how to handle the many different cleaning operations present in the production and manufacture of petroleum products.

Engineering methods since have put a very different significance into the term "cleaning". The developments referred to are of particular importance to the oil industry for several reasons. In the first place, the oil industry has made tremendous strides in meeting the demands for more perfect products and it is difficult to deliver finer petroleum products from equipment, tankers, tank cars, and containers that are contaminated with foreign matter. In the second place, as the efficiency of refinery equipment has been increased to give greater production, it has become doubly important to maintain the passages and surfaces of such equipment free of deposits and foreign matter so that the equipment maintains its original operating efficiency.

More than a score of years ago, cleaning as a systematic maintenance or production operation was taken up as a great engineering project. It was recognized that the cleaning requirements of industry were sufficiently varied and difficult to justify a thorough and orderly study of these problems in order to produce effective materials and methods to displace the previous ineffective operations.

The project was divided into two programs closely related to each other: (1), Chemical engineering research in the laboratory to develop effective cleaning *materials;* and (2), Mechanical and field engineering to develop efficient *methods* for all cleaning operations. These two branches of engineering work together already have produced great savings in labor and money in the petroleum industry.

*Oakite Products, Inc.

Cleaning Operations Are Classified

Cleaning operations differ as much as do people. So the engineer classifies the cleaning operations in order to study and prescribe the most effective methods for each. This classification gives a better opportunity for recognizing the object of a particular operation, the types and quantities of foreign matter to be removed, and the working conditions, so that practical recommendations can be made on the most suitable material for that operation, combined with an economical and practical method. For example, the oil industry is charted somewhat as shown in Fig. 1. From this outline, it readily is seen that the cleaning operations of producers, refiners, and distributors are given separate consideration to meet specific needs. There are special methods of cleaning lease tanks, etc., for the producers. In the case of refiners, the cleaning of heat exchange equipment and bubble towers has developed into an effective procedure. For the distributor, the washing of drums and trucks, and the cleaning of service stations for the sake of neat appearance, are handled in a manner especially devised for them. These examples indicate why necessity dictated the development of a wide range of cleaning materials and methods for applying them.

Study of Requirements

When specifying material and the method for each operation, the engineer must bear in mind all the practical requirements. Among these are:

(1) Safety to plant (reduce or eliminate fire hazard).

(2) Safety to men (non-injurious materials, elimination of slippery floors).

(3) Economy (minimum labor and expense).

(4) Time (keeping at a minimum, shut-down time of the refinery equipment being cleaned).

(5) Increased yield (by cleaner refinery-production equipment).

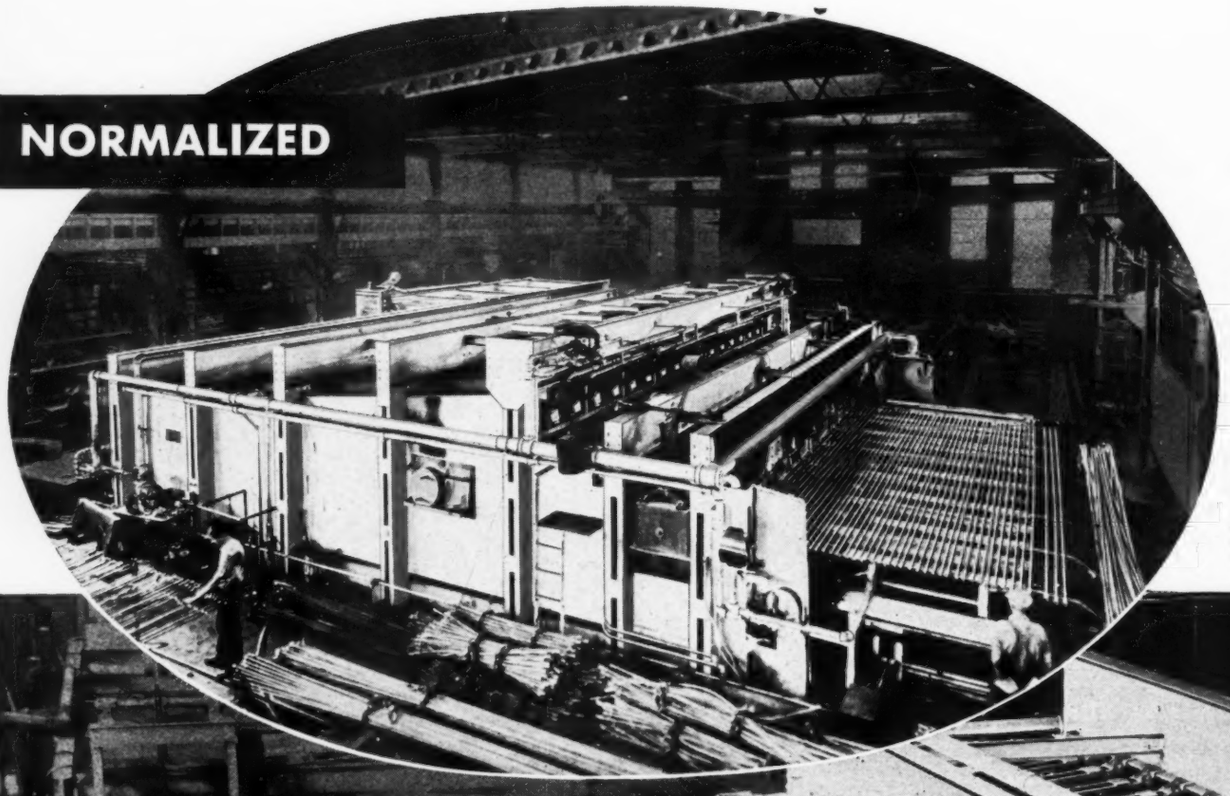
(6) Better petroleum products (by cleaner tanks, cars, drums, etc.).

Such a measuring stick must be constantly employed in order to be certain that the material and method specified will accomplish the purposes of each cleaning operation, and to keep the work economical and adaptable to actual working conditions.

Cleaning Heat Exchangers

An excellent example of the development of modern cleaning operations is the method developed for economically maintaining heat exchangers at maximum working efficiency. Throughout most oil refineries are found numerous pieces of equipment constructed on the principle of some form of heat exchanger. Among these are

Only "OILWELL



EXACTING PROCES
follows the sucker rod steel
ore through smelting and
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proper grain structure
Heat-treatment starts
normalizing furnace
WELL" sucker rods
over their entire length

AFTER NORMALIZ
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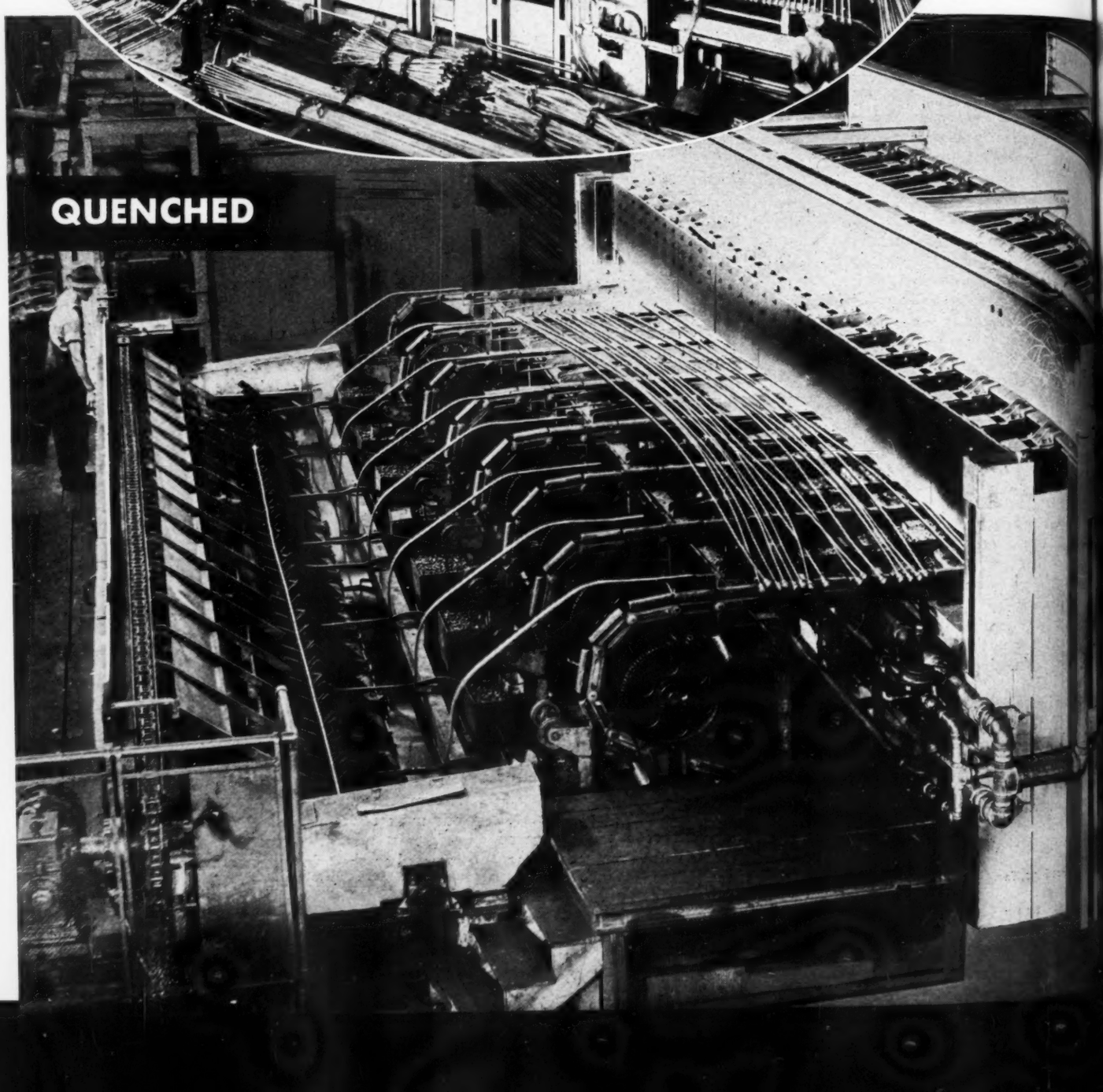


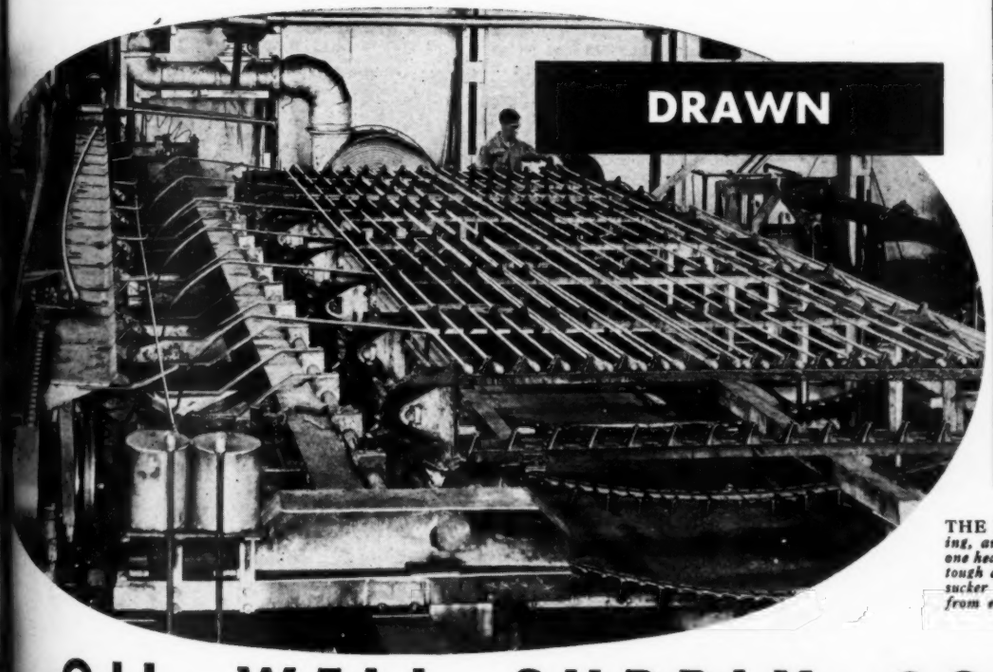
can say, "NORMALIZED, QUENCHED *and* DRAWN"

And only **"OILWELL"** *has heat-treating facilities to give you the exact sucker rod you need*

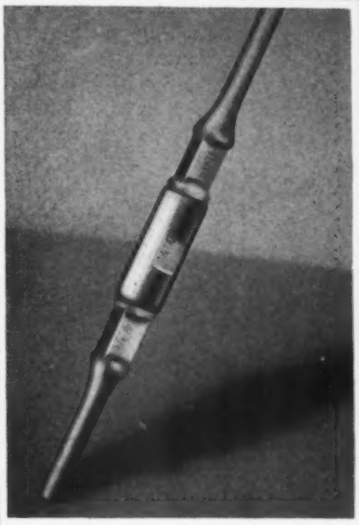
YOU can't pump oil wells economically unless the sucker rods have the chemical and physical properties best suited for the service requirements. The highest physical values for sucker rod steels can be obtained only by the normalize, quench, and draw process.

This full heat-treatment process is an exclusive "OILWELL" development and the manufacture of our sucker rods is protected by basic process, product, and equipment patents.

"OILWELL" Fully Heat-Treated Sucker Rods render maximum service. That is why we say — look to "OILWELL" for the best in sucker rods.



THE RODS, *after normalizing and quenching, are drawn (over their entire length in one heat) and proof tested. The rods are now tough and ductile—to the proper degree for sucker rod service—and of uniform quality from end to end.*



SUCKER ROD ENGINEERING SERVICE

"OILWELL'S" metallurgically and mechanically trained engineers are thoroughly qualified to analyze your sucker rod and pull rod problems. They will assist you in every way and specify the grade of rod best suited for your service requirements. Maximum economy and operating efficiency are available to those who make use of "OILWELL'S" thoroughly reliable field engineering service and fully heat-treated sucker rods.

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pre-heaters, condensers, process exchangers, steam generators, dephlegmators, and similar equipment. The constantly increased use of more efficient heat exchange equipment has been adding yearly to efficient refining.

From the day new heat exchangers of any sort are put into use accumulations begin to form on the heat transfer surfaces, reducing the working efficiency. In some instances the accumulation fortunately is slow and the equipment may operate for many years, whereas other equipment is operated with such materials and at such temperatures that it requires periodic cleaning, perhaps as often as every two months.

Deposits in such equipment reduce the operating efficiency in two ways: (1), any deposit on tubing surfaces retards the flow of heat through the walls of the tubes; and (2), bulky deposits interfere with the full capacity flow of the liquids through the equipment. Oil films particularly are serious in reducing the heat transfer, and large deposits require that the pumps be operated at higher pressure to force the liquids through a fouled exchanger.

The types of deposits vary greatly and it is necessary to determine what types of foreign matter are to be removed in order to select the proper materials for the particular job. On one side there may be heavy oil deposits that must be handled with a material of the kind suitable to emulsify and break down the tenacious gummy nature of the oil deposit so that it will be removed. If the equipment is water-cooled there may be a problem of removing a water scale. This has been a difficult problem to overcome. It is generally best to submit a sample of the scale and, if possible, a typical piece of one of the tubes, to a competent cleaning service laboratory so that they can first determine experimentally how best to handle the removal of the scale. They can then specify what materials should remove the deposits effectively and with complete safety to the equipment itself.

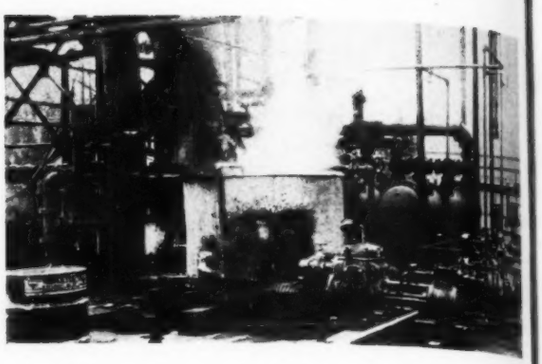


Fig. 3. Typical hook-up of the Oakite Method used in cleaning heat exchangers.

The method of cleaning heat exchangers as recommended and serviced by Oakite Products, Inc., is indicated in Fig. 2, which is taken from the Oakite Service Manual. This method requires essentially: (1), a large adequate pump; (2), an open solution tank in which to mix the cleaning material; (3), piping connections and valves; and (4), steam connection for heating the solution and steam or air connections to give added force and agitation to the cleaning solution while flowing through the heat exchanger.

This diagram is only typical and may be modified in a practical manner to meet most easily the conditions of each installation. This method, simple in principle, has been developed with several unique features:

(1) In developing "the reverse flow" principle, experience has shown that a far more thorough and a quicker cleaning is obtained by being able to change frequently the directional flow of the cleaning solution during the operation. For example, reversing the direction of flow every half hour over a cleaning period of eight hours has removed deposits that stubbornly resisted a much longer flow in but one direction. It generally is economical to add the necessary fittings and valves for quick reversal of flow.

(2) Providing connections for steam injection, as indicated, also has been a great aid in breaking up and removing deposits that resisted other treatment.

(3) The use of a settling drum before the cleaning solution returns to the Oakite tank also has been extremely helpful. If the deposits are of such a nature that a large volume of insoluble matter comes out with the cleaning solution it has been found preferable to trap the insoluble solution in a settling drum rather than permit it to be picked up by the pump and recirculated into the heat exchanger.

This method, wherever applicable, has tremendous advantages compared to removing the heads and dismantling the heat exchanger for cleaning by hand. Obviously there is much less labor in hooking up the pump tank and piping connections than in taking the heat exchanger apart, withdrawing the bundles of tubes, and then hand-scraping or wire-brushing the surfaces. This circulating method also is thorough, because the cleaning solution reaches all surfaces, whereas in cleaning by hand it frequently is impossible to reach many of the surfaces, especially if cleaning the outer surfaces of the tubes. There is much less wear-and-tear on the equipment also, because the circulating method cannot damage the heat exchanger, whereas there always is danger of injuring the equipment when it is taken apart. In addition, the method is very economical, not only in the actual cost of the operation itself, but also because the exchanger is out of production a much shorter time.

Fig. 3 illustrates a typical hook-up of the Oakite Method in use on cleaning heat exchangers. From this it is seen that it is a simple matter to bring a pump of moderate size and a small open tank of any sort to the vicinity of the exchangers to be cleaned, and to pipe them up for the operation.

An important link in this chain of work is the adapting of such cleaning methods to the different conditions en-

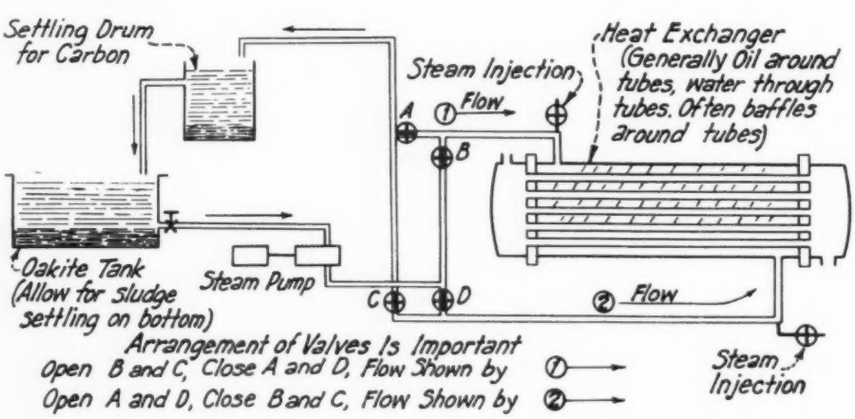

Settling Drum for Carbon
Steam Injection
Heat Exchanger (Generally Oil around tubes, water through tubes. Often baffles around tubes)
A
1 Flow
B
Oakite Tank (Allow for sludge settling on bottom)
Steam Pump
C
D
2 Flow
Steam Injection
Arrangement of Valves Is Important
Open B and C, Close A and D, Flow Shown by 1
Open A and D, Close B and C, Flow Shown by 2

Fig. 2. Method of cleaning heat exchangers. *(Copyright, Oakite Products, Inc.)*

countered in various fields or refineries. Consequently it became the duty of the engineer schooled in cleaning operations to train practical service men for the work. This has been a constant activity for many years, so that trained field service men are available at all localities to supply engineering data and prompt service for any type of equipment cleaning.

Many other equally effective cleaning operations have been worked out in an engineering manner. Among these, of particular interest to the oil industry, are: the method of cleaning the water jackets of Diesel engines, the cleaning of compressor jackets, and the cleaning of air filters for compressors; but these operations are important enough to be covered in another article to be published at a later date.

Handy Chart Determines Power Consumed by Bearings

By
W. F. SCHAPHORST

LAY a straightedge across the accompanying chart three times, as indicated by the dotted lines, and it will give the hp. consumed by any bearing, coefficients of friction varying from .0006 to 0.6; shaft diameters from 0.1 to 10 in.; r.p.m. from 100 to 10,000; and the load on the bearing from 10 to 10,000 pounds.

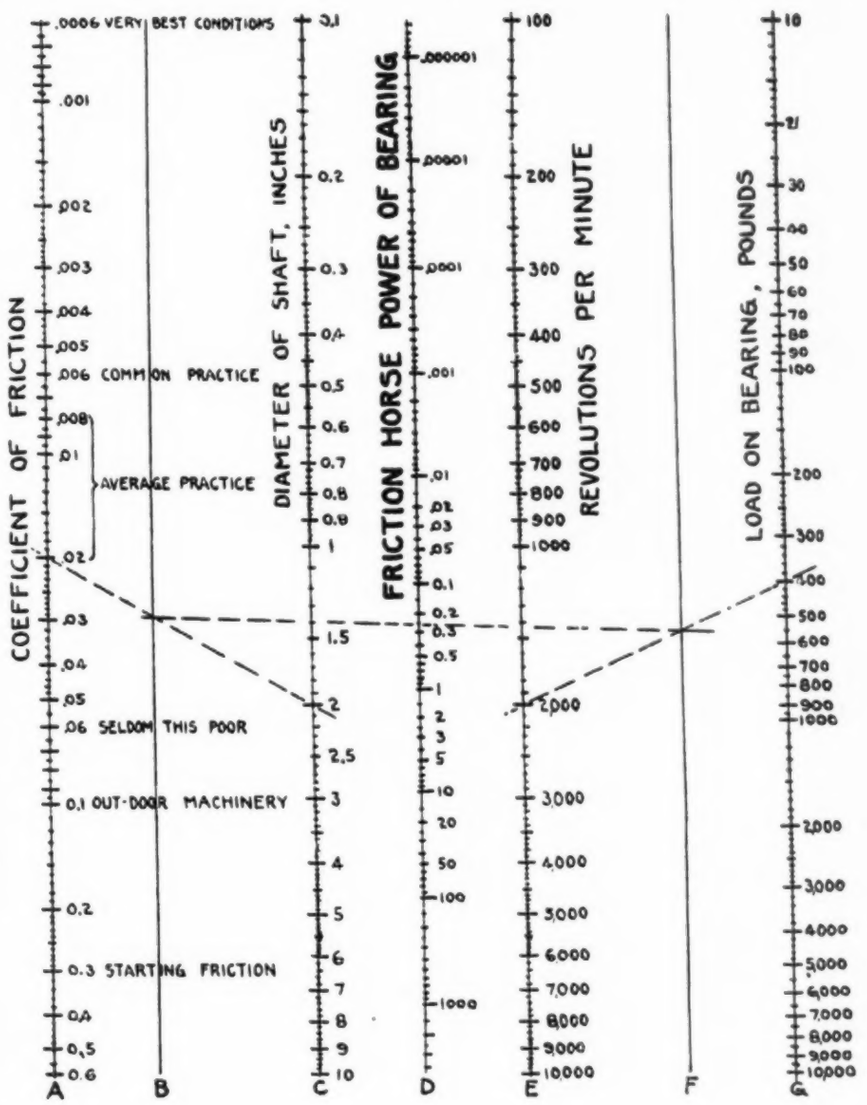
For example, using a coefficient of friction of .02 (column A), which is average practice, a shaft diameter of two in. (column C); a speed of 2000 r.p.m. (column E), and a 400-lb. load on the bearing (column G), column D shows the friction hp. as a little over 0.25.

Connect the known value in column A with the known value in column C and locate the intersection with column B. In the same way connect columns E and G, and locate the intersection with column F. Lastly, connect the intersections (columns B and F), and the intersection with column D shows the friction hp. of the bearing.

Column A gives an idea of the coefficients met with in every-day practice, beginning with the very best conditions and ending with starting friction.

Coefficients of friction under the many possible conditions are given in text books, in Alford's "Bearings," and in such handbooks as "Kent" and Marks' "Mechanical Engineer's Handbook."

Only the general safe values of practice are designated on this chart. The principal function of the chart is to quicken the making of computations for anybody who has to do with bearings.



The chart, of course, can be used backwards as well as forwards. Thus if the power absorption by a given bearing is known, and if values in columns C, E, and G are known, the coefficient of friction is quickly determinable. Then, knowing the coefficient of friction with a given oil and in a given bearing, the power required by a similar bearing of different diameter, speed, and loading may be found with an accuracy sufficient for most practice.

The chart explains many things, teaches many lessons. For example, for belt transmission practice it tells us to run belts with as little tension as possible; to run shafts at low speeds if possible; to use small shafts preferably, and to keep the bearings well oiled, with the proper oil, and in good condition.

Quieting Exhaust Pulsations

Noise caused by engine exhausts reduced by novel device worked out by a pipe line company's operating personnel

By ELTON STERRETT

USUALLY rushed to completion as an oil field develops and the need for rapid crude transportation becomes imperative, the pipe line pump station is outfitted with the most convenient source of power, taking operating economy and initial cost into consideration.

Many pump stations favor internal combustion engines, either Diesel or natural gas, with preference shown the larger, stationary types, whether of the two- or four-stroke cycle. These engines usually are equipped with some sort of muffler, as the din caused by a battery of, say, 10 by 14 Diesels exhausting directly into the air would be so deafening as to make it impossible for the operators to check other equipment under their care; but as most pipe line stations are situated away from cities or towns, the problem of effectively quieting exhaust pulsations is secondary, or completely ignored.

Frequently, however, with the development of an oil field the small town may grow directly toward the pumping station, and then the factor of exhaust noise becomes of increasing importance. In one instance in a Texas field a modern hospital was built and actually tenanted with patients before anyone realized that the exhaust roar from a neighboring pump station made some of the rooms untenable for a well person, much less suitable for a sick person. Under certain station load and atmospheric conditions the vibrations set up by the thundering exhausts shook the windows so severely it was impossible to keep putty in them, bottles of medicine would gradually "walk" across shelves and fall to the floor, and light bulbs in rigid fixtures could not be kept tight—all this, although the station was at least a hundred yards from the hospital.

As a preliminary step toward silencing, or at least reducing, the noise of the exhausts, a survey was made of methods employed elsewhere for the same purpose. Investigation of the passage of hot gases through an exhaust pipe showed that alternate sections are relatively compressed or rarefied; these compressed sections acting much like the blast from a rifle as the powder gases pass the muzzle. If the exhaust pipe be cut off squarely, there is nothing to prevent the maximum impact of these gases upon the surrounding air, and the noise so created is greatest.

A favorite means of "stretching" this impact of gases is that of bevelling the end of the exhaust pipe. An angle of 30 deg., as shown in Fig. 1 (A), gives the maximum of effective bevel without sacrificing rigidity of the pipe end, and is an angle easily cut by the welder with his torch. If the exhaust line be vertical, the bevelled portion should not face directly toward any nearby perpendicular object, such as a tank or other building, as this may act as a sounding board to amplify the noise. If the line projects horizontally and the bevel is downward, care must be taken that it is not backed with a similarly inclined slope, or that any baffle large enough to cause an echo is within 100 yards of the pipe end.

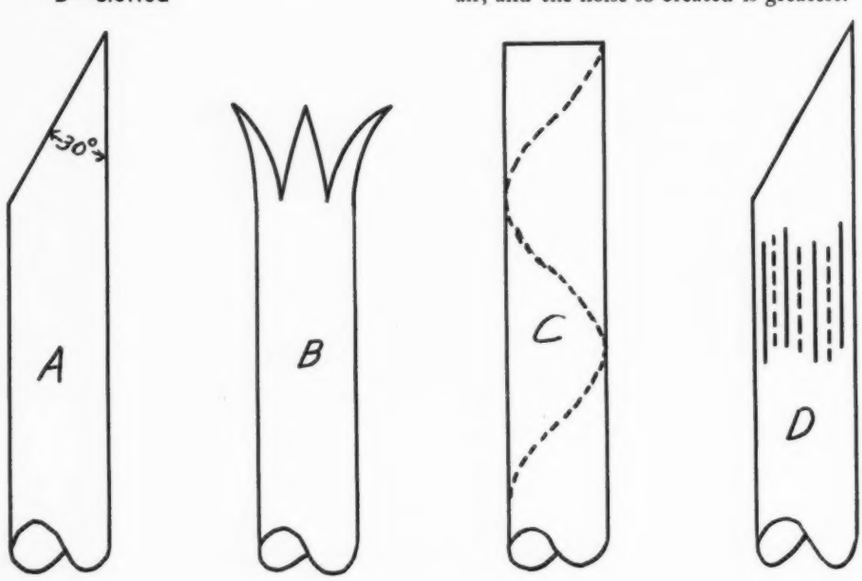
Another type of exhaust end, borrowed from the days when designers sought to equalize the draft of the exhaust on the ornate river steamboats of their time, is the "crown" or "coronet" type shown in Fig. 1 (B). With such a tip, the exhaust gases break up as they tend to follow the different points, while outside air can join readily the rapidly flowing stream through the wedge-shaped apertures between the prongs. This type loses its effectiveness rapidly with multi-cylinder engines, and is useless if the exhaust impacts exceed 400 per minute.

A different type of silencing tip, which seems to be much more effective with two-cycle than four-cycle engines, is that shown in Fig. 1 (C). To form this, a light angle iron—for a 6-in. or 8-in. diameter exhaust pipe the angle is either ¾ in. by 1 in. or 1 in. by 1¼ in.—is coiled to form a spiral having one and one-half turns in approximately four feet of length. This spiral is then riveted, bolted, or tack-welded on its narrower side inside the last four feet of the exhaust line, so that the charge of gases is given a pronounced whirling motion as it emerges. Either this whirling motion or the fact that the spiral retards the outer portion of the pulsating column of gases while the interior may move forward more rapidly results in a marked lessening of the throb or beat.

Slotting the exhaust pipe a short distance from the end permits a portion

Fig. 1—Types of exhaust pipe ends:

A—Beveled end
B—Crown or coronet type
C—Rifled or spiral vane
D—Slotted



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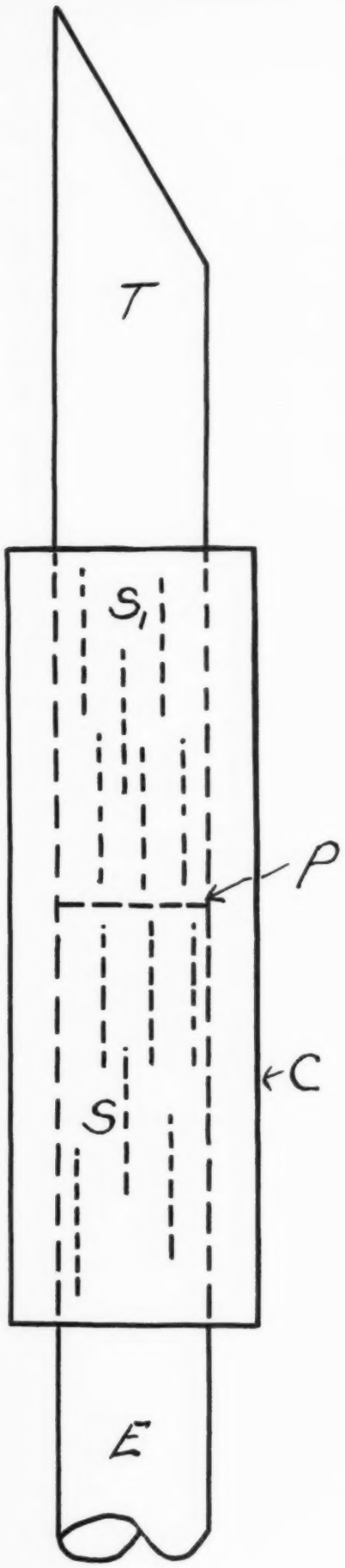


of the exhaust to escape through these apertures, thus lessening the volume released at the end of the pipe. These slots also permit outside air to enter the exhaust pipe between pulsations, thus decreasing the variation in pressure as the separate cylinder exhausts reach the end. This type is shown in Fig. 1 (D).

Since each of these characteristic exhaust pipe-ends diminished but did not quiet the exhausts, the pipe line officials did not feel that the adoption of any one would benefit the hospital materially, and plans were then developed for what is in effect a secondary muffler. A model, made of galvanized iron, was so effective on the small engine powering the station "air-jammer" that an experimental installation was placed on one of the large engines, and there exceeded all expectations.

The original exhaust riser, of 6-in. pipe, extending as "E-T" in Fig. 2, was taken down and cut apart at "P", 27 in. below the lowest point in the beveled tip. A disc of tank plate was then welded in to close the end of "E" and the severed section "T" then welded back in place. With the line again joined, ¼-in. slots approximately six in. in length were cut, with the torch, through the walls of both "E" and "T" near the closure at "P", being staggered and at irregularly spaced intervals. After the slots were cut, a drum of light 10-in. pipe, with its ends of tank plate cut to allow the exhaust pipe to pass through concentrically, was set in place to cover these slots and welded there tightly.

In operation the exhaust gases travel "E" and, being diverted by disc "P", emerge gradually through the slots at "S" into the annular space between "E" and "C", finding their only escape through similar slits "S_1" into the pipe "T". With the bevel at the top faced away from the hospital, and all units operating at 25 percent overload, the exhaust on the trial engine was so effectually quieted that the device was duplicated for the entire battery—the change from the earlier deafening racket being so marked that many hospital visitors asked if the pipe line had been shut down. The "whisperer," as the station men called it, is now standard equipment on all engines run by that pipe line regardless of the distance to the nearest neighbor.

Fig 2—"Whisperer":
E, T—Old exhaust
S, S—Slots
P—Dead end
C—Shell
Scale: ⅛ in. to 1 in.

New Method of Measuring Arc Temperatures

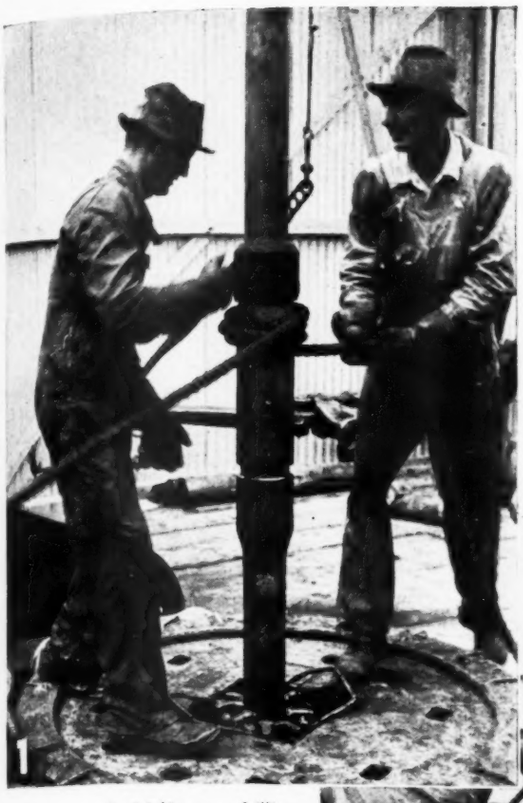
A NEW high-speed photographic method of measuring arc temperatures, observing the wave front of a sound wave passing through the arc, has yielded valuable information on welding phenomena, says P. L. Alger, of General Electric Company, in reviewing the progress of engineering knowledge during 1936. Average temperatures of cored-carbon and tungsten arcs were found to be 5500 K. and 6440 K., respectively. A Type W-20 electrode iron-iron arc, carrying 125 amp., was found to fluctuate between 4400 and 7000 K.; averaging about 6000 K. This average temperature corresponds to an 81 percent dissociation of the arc atmosphere, and so points to the great importance of the dissociation - diffusion - recombination process of heat transfer in normal arc-welding processes. An arc in air at atmospheric pressure is now known to be an electrical discharge in which there is thermal equilibrium between the electrons and atoms or molecules present, in contrast to the discharges in vacuum tubes where the electrons may move with velocities corresponding to temperatures tens of thousands of degrees in excess of the temperature of the widely scattered gas molecules. The time required to reach thermal equilibrium in an ordinary welding arc in air is of the order of 0.001 second.

Turbine-Generator Cooled By Hydrogen

A RECENT major development has been the renewed demand for large turbines, and nearly half of these new machines were designed for superposing on previously installed machines to modernize the plants and supply needed additional capacity at low-operating cost, says John Liston, of the General Electric Company, in making his annual review of the electrical industry.

The 50,000-kva. turbine generator, also a superposed unit, for the Logan, West Virginia, plant of the Appalachian Electric Power Company is the first commercial turbine-generator to be hydrogen-cooled and its design was based on 12 years of planning. Hydrogen-cooling is of particular advantage in these high-speed machines, because hydrogen reduces the main items of loss, friction, and windage, to one-tenth their value with air. The Logan generator is equipped with water-cooled pads between the laminations of the armature.

One string of Pipe drilled 4 wells at Rodessa



1. Making up drilling string at Rodessa well. Note protection to tool joint by Protector.

2. Running in external upset drill pipe.

3. Ready to make up another string.

PIPE LIFE LENGTHENED with PATTERSON-BALLAGH PROTECTORS

100% PROTECTION with the RIGHT KIND of PROTECTORS

At Rodessa, drilling contractors and crews are taking pride in the lengthened life of equipment they are obtaining. Patterson-Ballagh Pipe and Casing Protectors are used in the majority of wells, much to the satisfaction of the crews. The drilling string illustrated here has been used for four Rodessa wells. The external upset drill pipe has not lost any diameter. It's practically as good as new. The rubber Protectors are giving 100% protection.

Write for Bulletin. Stocks Carried by Supply Stores.

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LAUGH WITH BARNEY

Edited by BARNEY HORRIGAN

Teacher: If "Minnie" in Indian means "Water," what does "Minnesota" mean?

Pupil: Soda water.

* * *

Have you heard about the kids who made a snow man on a side street and put a shovel in his hand? Well, a couple of days later a WPA foreman came along and gave him a check.

* * *

The teacher was giving the youngsters a mental drill. "Now, Bobby, tell me which month has 28 days in it."

Bobby had forgotten. After a moment he had the answer, "They all have."

* * *

"You've already had leave, Jones, to see your wife off on a journey, for your mother-in-law's funeral, for your little girl's measles, your boy's christening—what is it now?"

"I'm going to get married."

* * *

"Hello," said a feminine voice over the phone, "is this the Humane Society?"

"Yes", replied the official in charge.

"Well, there's a book agent sitting out here in a tree teasing my dog."

* * *

Professor's Wife, "Hello, is that the police station?"

"Yes, what's the matter."

"I just wanted to tell you that you need not search for my husband. I found him myself. He had forgotten to take off his overcoat, and I hung him in the closet by mistake."

* * *

The old chiseler limped painfully up to the bar and leaned against it in an attitude of dejection.

"What's the matter?" asked a sympathetic friend. "Have an accident?"

"No," replied the chiseler, "I've just had a touch of the yoors."

The sympathetic guy scratched his head. "What's yoors?" he wanted to know.

"I'll take a straight whisky, thanks."

—*Pure Oil News.*

* * *

Bum: Say, Buddy, could you let me have a dime for a cup of coffee?"

Wise Guy: A dime? I thought coffee was only a nickel?"

Bum: I know it, but I gotta date.

The newlyweds were on their honeymoon. They had the drawing room and the groom gave the porter a dollar not to tell anybody on the train they were just married. When the happy couple went in for breakfast next morning all the passengers snickered.

The groom called the porter and demanded: "Did you tell anybody on the train we were just married?"

"No, sir," said the porter. "I told 'em all you all was just good friends."

* * *

"Do you serve women at the bar?"

"No. You'll have to bring your own."—*Bridgeport Bulletin.*

* * *

"I'm going to kiss you under the mistletoe when I go," said the guest who had tarried so long that he was wearing out his welcome.

"Do it now, while I'm still young," she replied wearily.

* * *

The doctor was interviewing the last patient in his office when a woman rushed in crying: "Doctor! Doctor! Come quickly. My husband has swallowed a mouse!"

"Get back to him," said the doctor, "and try waving a piece of cheese about in front of his mouth. I'll follow."

Five minutes later the doctor reached the house. A man was lying on a settee with his mouth wide open, while a hysterical woman was waving a kipper close to his mouth.

"You foolish woman," he cried. "I told you cheese."

"I know that," she shrilled, "but I've got to get the cat out first!"

* * *

Man in swimming: Are you sure there are no crocodiles about?

Negro on shore: Yes, suh! De sharks done scare 'em away, suh.

* * *

A reformer is the kind of guy who would try to make you believe that he gave Eve back her apple.

* * *

"Boy, oh boy! That was some blonde with you last night. Where did you get her?"

"Dunno, I just opened my billfold and there she was."

Dora: I see where a young wife presented her 85-year-old hubby with a baby boy. What do you think of that?

Jack: The same as you.

* * *

A man was charged with shooting a number of pigeons, the property of a farmer. Counsel for the defense tried to frighten the farmer.

"Now," he remarked, "are you prepared to swear that this man shot your pigeons?"

"I didn't say he did shoot 'em," was the reply. "I said I suspected him of doing it."

"Ah! Now we're coming to it. What made you suspect this man?"

"Well, firstly, I caught him on my land wi' a gun. Secondly, I heard a gun go off and saw some pigeons fall. Thirdly, I found four o' my pigeons in his pocket—and I don't think them birds flew in there and committed suicide."

* * *

Then there is the case of the ambitous young man who started on a shoe string and got slapped.

* * *

A woman looks upon a secret in two ways: Either it is not worth keeping, or it is too good to keep.

* * *

A man rushed up to the new negro orderly at the hospital, excitedly asking: "Where is the maternity ward?"

"Which one is yo' lookin' for, boss?" queried the new orderly, "de ladies 'er de gentmun's?"

* * *

Timothy Hay: Yes, I've seen a few bad crop years in my time, too. One year our string beans were so poor the crop didn't even pay for the strings.

Al Falfa: That's nothing, Tim. In '94 our corn crop was so bad that my old dad, who had a very poor appetite, ate 14 acres of corn at a single meal.

—*Pure Oil News.*

* * *

Girls who are good cooks marry soon. But girls who are bad cooks marry more often.

* * *

Bing: What do you mean, kicking my dog? He don't even bite.

Bang: Yes, but he raised his leg, and I thought he was going to kick me.

E. W. BECK has been made assistant manager of purchases for the General Petroleum Corporation, Los Angeles, California. He has been with the company since 1920.

W. C. LANE of Tulsa, Oklahoma, is acting in the capacity of consulting engineer for Ed Moore, Inc., in erecting a 200-well capacity electric generating plant in the Fitts Pool, Pontotoc County, Oklahoma.

H. C. ANDERSON, deputy conservation officer of the Texas Railroad Commission at Marshall, Texas, has become associated with **R. W. NORTON,** independent operator of Shreveport, Louisiana, as assistant to the latter. **E. B. WHARTON,** petroleum engineer, also has become associated with Norton.

C. E. WRIGHT has been made general superintendent of the production department of the British American Oil Producing Company, **WILLIAM K. WHITEFORD,** vice-president, has announced. Wright has been in charge of Oklahoma City operations of the company. **C. V. SIDWELL,** who has been general superintendent of production, will organize and be in charge of the production engineering department.

DR. GERALD L. HASSLER, assistant professor of petroleum engineering in the School of Mineral Industries at the Pennsylvania State College, has resigned to join the staff of the Shell Development Laboratory at Berkeley, California.

R. D. COPLEY, acting district petroleum engineer in Southern California for the Standard Oil Company of California, is now with the California Company and has been transferred to Denver, Colorado. **P. C. McCONNELL,** who has been district petroleum engineer of the Southern Division for the Standard, will occupy the same post with headquarters at Taft. **R. I. BROWN,** district petroleum engineer for the San Joaquin Valley, has been transferred to Los Angeles and made district engineer in Southern California.

W. T. DABBS has been made superintendent of the Hurdle and Big Lake districts by the Humble Oil and Refining Company. He has been tool pusher for the company in the Sand Hills district, West Texas.

MAX S. LOY, of Bradford, Pennsylvania, is in charge of the South Texas office of Sloan and Zook Company opened in San Antonio on January 1st.

R. J. SULLIVAN, who has been superintendent of gasoline plants in East Texas for the Humble Oil and Refining Company, has been transferred to the Houston office. **G. C. PATTERSON** succeeds to Sullivan's vacated post. He has been gasoline plant foreman in the London district of East Texas.

ROGER QUINTANILLA, pipe line foreman in the Toteco district for the Mexican Gulf Oil Company, has been released from a Houston, Texas, hospital, where he underwent an operation recently.

A. ROZLOSNIK and **EMILIO MONTANE,** engineers with the Argentine Government Oil Fields, Buenos Aires, are in the United States making a study of production methods in the various fields.

EDUARDO CARLOS LAZO, of the Agencia E Inspeccion Technica de Petroleo of the Government of Mexico, has returned to his headquarters at Tampico, Mexico, following some time spent in the Mid-Continent fields studying operating methods.

T. B. LAMBERT, petroleum engineer, has been transferred by the Shell Petroleum Corporation from Shreveport, Louisiana, to Iowa, Louisiana.

BYRON LOW, superintendent for the Humble Pipe Line Company in the Texas Panhandle district, is now in the Houston office of the company. **CHARLES ALFORD,** chief gauger at McCamey, succeeds to the Panhandle post and has his headquarters at Amarillo.

SAM A. MURPHY, independent operator, has moved his offices from Winfield, Kansas, to Wichita. **JOE MURPHY,** his son, who has been with the Bovaird Supply Company, again is associated with his father.

S. F. MAUNEY, JR., chemical engineer for the Carter Oil Company, having his headquarters in Tulsa, Oklahoma, has been made division petroleum engineer and transferred to Seminole, Oklahoma. He succeeds **EVAN JUST,** resigned. **CHARLES M. RICHARDSON** takes over Mauney's old post at Tulsa.

BEN G. BARNETT has announced the moving of the offices of the Barnett Petroleum Company from Houston to Dallas, Texas. He is president of the company.

H. J. SCHROEDER has resigned his position in the engineering department of the Stanolind Oil and Gas Company to go with the U. S. Bureau of Mines. He will be stationed at Amarillo, Texas.

F. L. MELVILL, assistant general manager of Trinidad Leaseholds, Ltd., is now on leave and has left Trinidad for South America, where he will remain for some time, going to England in May in time to witness the Coronation.

FRED HASKELL, Bartlesville, Oklahoma, manager of the Empire Pipe Line Company, recently visited Bradford, Pennsylvania, his former home.

EARL A. SMITH, who has been assistant superintendent of the refinery of the Canadian Oil Companies, Ltd., at Petrolia, Ontario, Canada, has been made superintendent to succeed **CLOYD A. HALE,** deceased.

WILLIAM KENDALL, JOHN D. O'MARA, and **J. E. DOUGHTITE,** all of Shreveport, Louisiana, have formed the D.O.K. Oil Corporation.

SAM GINSBERG has been made general manager of the Garfield Petroleum Corporation, Clare, Michigan.

FUN-*da-mentals*

THERE WAS ONCE A DRILLING CONTRACTOR,
TO WHOM COST WAS NEVER A FACTOR,
HE BID JUST BELOW WHERE HE THOUGHT IT WOULD GO
AND NOW HE IS GREASING A TRACTOR.

By C. J. PAINE, *of F. B. Paine Drilling Company, Tyler, Texas*

EDITOR'S NOTE: If yours appears in this space, we will send you the original artist's drawing (done in full colors).

WE WANT YOU ON OUR EDITORIAL STAFF...

HERE'S HOW!

Now is your chance to exercise a spare brain cell. Write a FUN-*da-mental* for us. FUN-*da-mentals* are mental gymnastics full of fun and facts—truths in the guise of the vernacular. Here's the way you proceed:

First: You must be a subscriber to THE PETROLEUM ENGINEER; that is, the signature appearing on your contribution must correspond with that on our subscription list.

Second: Just turn yourself loose and write a verse—we will furnish the cartoon interpretation each month of the one we consider to be the best.

Third: For the FUN-*da-mental* we select as suitable for first prize we will mail to the author the beautiful water color original drawing from which the engraving is made.

Fourth: For each FUN-*da-mental* that is selected to appear in this column, other than that winning first prize, we will mail to the author a check for $1.00.

All FUN-*da-mentals* must be signed by the originator or author.

All FUN-*da-mentals* sent to us shall remain the property of THE PETROLEUM ENGINEER.

We reserve the right to accept or reject any or all FUN-*da-mentals* and our judgment shall be final.

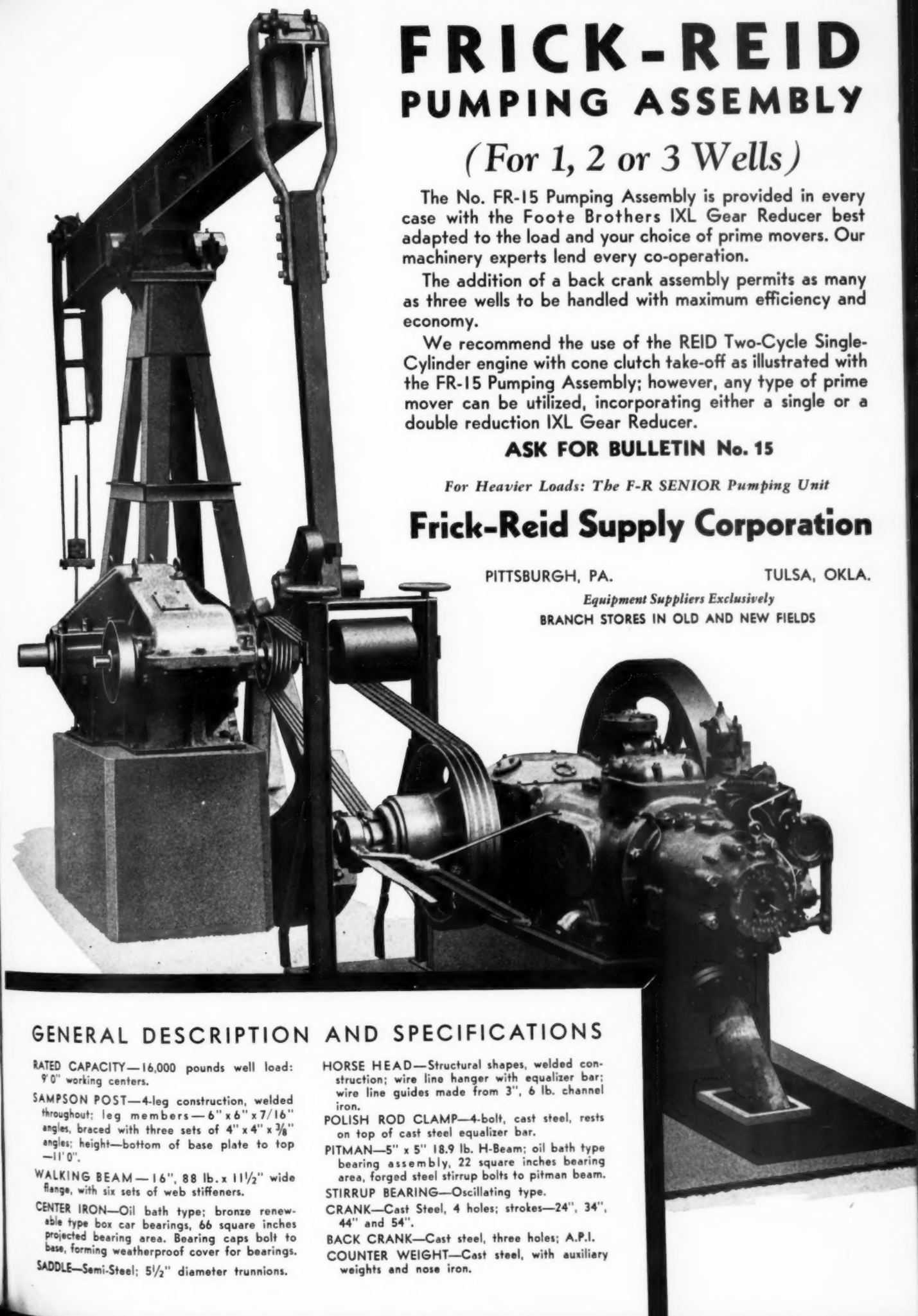
NOW . . try your hand at this contest—who knows but that you will be the lucky author and receive a beautiful water color cartoon interpretation of it framed and ready to hang on your wall.

A guy with nefarious intentions
Just chock-full of phony inventions
Tried to market his oil
For almost nothing at all.
Now he bawls for a state old-age
pension. * * * *

A man with a yen to be smarter
Started drilling where he hadn't 'orter.
He kept deepening his well,
Then shouted, "Aw, Hell,
I've discovered a pool of salt water."

. . . and, if it appears in this column we will send you a check for $1.00.

WRITE A FUN-*da-mental* AND SEND IT IN TODAY!



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(For 1, 2 or 3 Wells)

The No. FR-15 Pumping Assembly is provided in every case with the Foote Brothers IXL Gear Reducer best adapted to the load and your choice of prime movers. Our machinery experts lend every co-operation.

The addition of a back crank assembly permits as many as three wells to be handled with maximum efficiency and economy.

We recommend the use of the REID Two-Cycle Single-Cylinder engine with cone clutch take-off as illustrated with the FR-15 Pumping Assembly; however, any type of prime mover can be utilized, incorporating either a single or a double reduction IXL Gear Reducer.

ASK FOR BULLETIN No. 15

For Heavier Loads: The F-R SENIOR Pumping Unit

Frick-Reid Supply Corporation

PITTSBURGH, PA. TULSA, OKLA.

Equipment Suppliers Exclusively

BRANCH STORES IN OLD AND NEW FIELDS

GENERAL DESCRIPTION AND SPECIFICATIONS

RATED CAPACITY—16,000 pounds well load: 9'0" working centers.

SAMPSON POST—4-leg construction, welded throughout; leg members—6" x 6" x 7/16" angles, braced with three sets of 4" x 4" x 3/8" angles; height—bottom of base plate to top—11'0".

WALKING BEAM—16", 88 lb. x 11½" wide flange, with six sets of web stiffeners.

CENTER IRON—Oil bath type; bronze renewable type box car bearings, 66 square inches projected bearing area. Bearing caps bolt to base, forming weatherproof cover for bearings.

SADDLE—Semi-Steel; 5½" diameter trunnions.

HORSE HEAD—Structural shapes, welded construction; wire line hanger with equalizer bar; wire line guides made from 3", 6 lb. channel iron.

POLISH ROD CLAMP—4-bolt, cast steel, rests on top of cast steel equalizer bar.

PITMAN—5" x 5" 18.9 lb. H-Beam; oil bath type bearing assembly, 22 square inches bearing area, forged steel stirrup bolts to pitman beam.

STIRRUP BEARING—Oscillating type.

CRANK—Cast Steel, 4 holes; strokes—24", 34", 44" and 54".

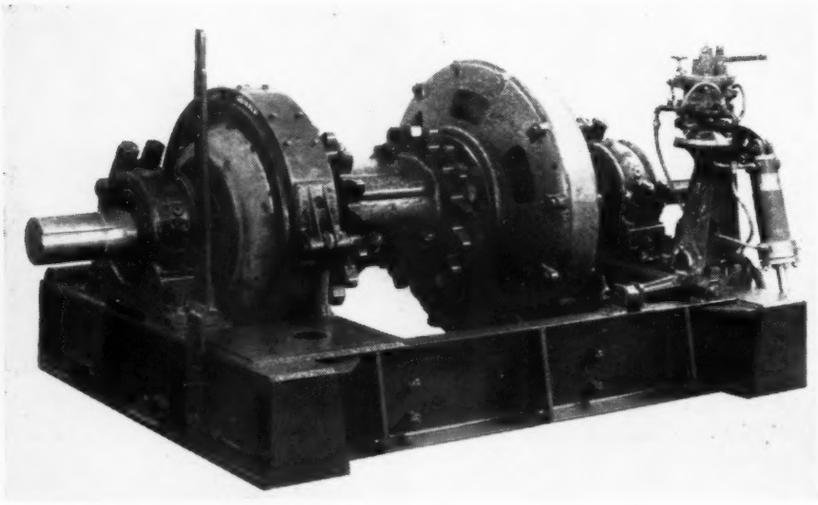
BACK CRANK—Cast steel, three holes; A.P.I.

COUNTER WEIGHT—Cast steel, with auxiliary weights and nose iron.

MACHINERY and EQUIPMENT

The Emsco Type "J" Reverse and Friction Clutch

THE Emsco Derrick and Equipment Company, Los Angeles, California, has extended its line of reverse and friction clutches by the introduction of a new model known as the Type "J." It is similar in design to the Type "H." The Type "J," however, is a large model and has a rotary drilling capacity of two hp. per revolution, i.e., 200 hp. at 100 r.p.m., etc.



The Type "J," like its companion model, is a separate unit in itself, the entire clutch and reverse assembly being mounted on a specially-constructed rigid frame so that the component parts are completely in alignment at all times.

Flexibility of operation was thoroughly considered in the design of the Type "J," the makers state. It may be operated manually, or even more simply by an air control; moreover, the main operating shaft extends the full width of the machine so that the controls are available at either end. The clutch and reverse mechanisms are all connected, and controlled by a single hand lever, the movement of which is identical with that of the forward and reverse lever of steam engines. Both ends of the main shaft are extended to accommodate sprockets, and the sprockets can be attached or removed without disturbing any parts of the assembly.

The split driving drum sprocket has been designed for cut or cast tooth, either single or double, to provide for universal adaptation with various types of drives. This sprocket likewise can be removed without disturbing any part of the assembly.

In the Mid-Continent this new unit, like all other Emsco machinery, is handled exclusively by the Continental Supply Company.

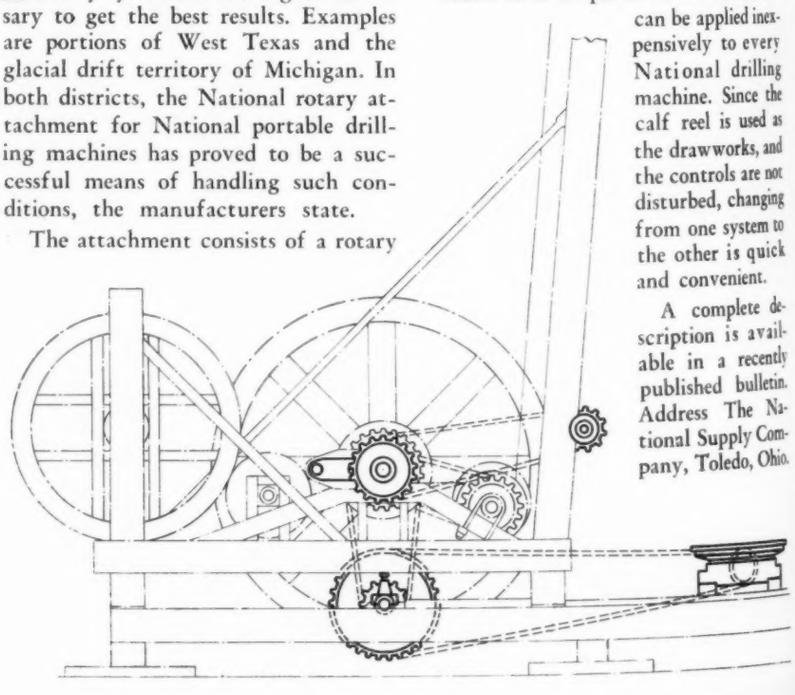
Wilson No. 520 Electrode

A NEW electrode has been announced by the Wilson Welder and Metals Company, 60 East 42nd Street, New York, N. Y. To be known as the Wilson No. 520, it is claimed that this rod will provide the welding industry with a perfect electrode for use with the small transformer type a-c. arc welders. Operators find it easy to handle, and that it works equally well with a-c. or d-c. machines, the manufacturers say. Good-looking bead deposits are the result, and slag interference is reduced to a minimum, with removal simplified.

Rotary Attachment for National Portable Drilling Machines

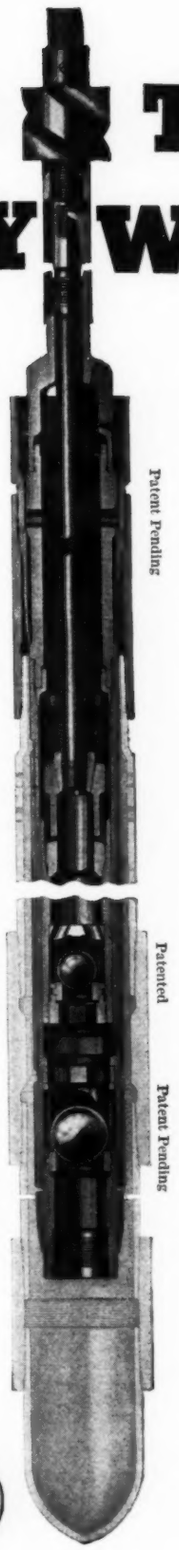
IN some fields both cable-tool and rotary systems of drilling are necessary to get the best results. Examples are portions of West Texas and the glacial drift territory of Michigan. In both districts, the National rotary attachment for National portable drilling machines has proved to be a successful means of handling such conditions, the manufacturers state.

The attachment consists of a rotary table drive and a cathead drive and shaft. It is simple in construction, and can be applied inexpensively to every National drilling machine. Since the calf reel is used as the drawworks, and the controls are not disturbed, changing from one system to the other is quick and convenient.



A complete description is available in a recently published bulletin. Address The National Supply Company, Toledo, Ohio.

HANG THIS PUMP IN SANDY WELLS



It's an Axelson R.S.L. Pump

Here is a pump that the operator of wells making sand, water and gas has been looking for. It is a rod sectional liner pump of the stationary type with top-lock hold-down guide coupling, Perry-Barnwell plunger and combined collar and cage. The top-lock hold-down feature allows the pump to be suspended from its upper end. Removal of the pump is greatly facilitated because there is no settling or packing of sand between the barrel and the well tubing. The locking device assures positive anchorage yet does not prevent removal of the pump. This type of pump is composed of a barrel unit which remains stationary with the well tubing and a plunger unit traveling with the sucker rods. The working valve which incorporates the Perry anti-gas-lock feature is located at the lower end of the plunger assembly. This brings it into the closest possible proximity to the combined collar and cage, (standing valve), minimizing gas-lock. The upper end of the plunger is shown with the Barnwell sand scraper feature which minimizes abrasive action between the plunger assembly and the barrel.

The guide type paraffin scraper coupling at the extreme top end of the pump should always be used above every Axelson Pump. It acts as a guide, centralizing the plunger and eliminating the bending or flexing of the pump rod.

Write today for further data on sizes and assemblies available.

Many Combinations Available for this Assembly

Liners
- Regular
- Hard Iron
- S. S. Hardened Steel
- Nitri-cast-iron

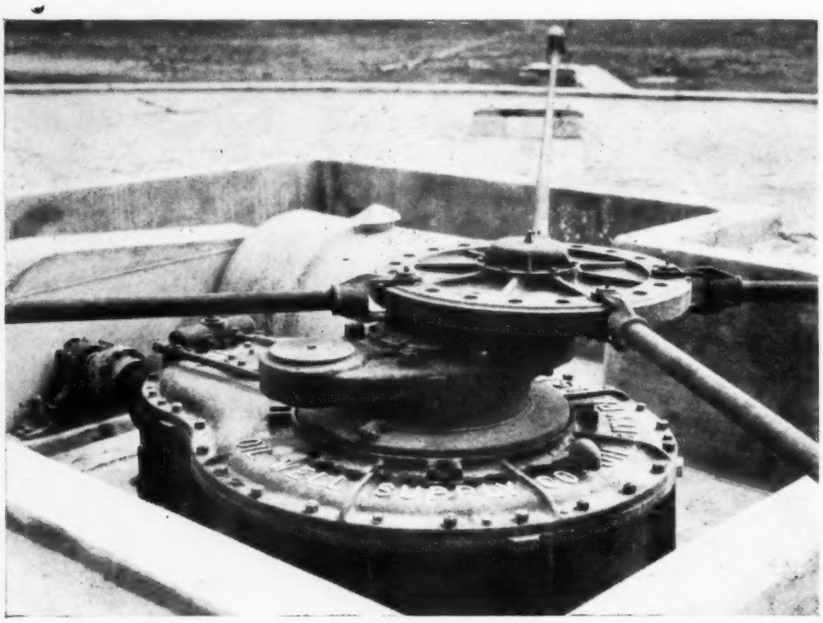
Plungers
- Regular
- Grooved
- Chromium Plated
- S. S. Hardened Steel
- Perry
- Barnwell
- and any combinations of these types

Seats & Balls
- Axloy
- X-L
- Durax
- Acme
- Plain or upset API tubing threads

Axelson Manufacturing Company, P. O. Box 710, Vernon Station, Los Angeles • St. Louis • 50 Church Street, New York • Tulsa
Mid-Continent and Eastern Distributor: Frick-Reid Supply Corp. • *Rocky Mountain Distributor:* Great Northern Tool & Supply Co.

DEEP WELL PLUNGER PUMPS **AXELSON** SUCKER RODS

"Oilwell" No. 100-SC Oilbath Geared Power



THE No. 100-SC is an addition to the line of oilbath geared powers manufactured by the Oilwell Supply Company for central pumping installations. It is rated at 100 hp. at 20 s.p.m. for oil field service. It is equipped with the exclusive "Oilwell" dual-stroke crank (holes for 30-in. and 36-in. stroke) and, like all other "Oilwell" oilbath geared powers, is entirely weatherproof, and features the stationary spindle construction, that is, the main gear and crank revolve as a unit around the stationary spindle.

Features of the equipment, and advantages claimed for it by the manufacturers, are:

Low Initial Cost

1. *Economically priced*—reasonable price made possible by simplicity of construction.
2. *Low transportation cost* — compact; ample strength without excessive weight.
3. *Requires no power house*—fully-enclosed; weather-proof.
4. *Minimum belting expense*—short V-belt or direct drive.
5. *Inexpensive foundation* — compact construction and minimum height of pull-rod connections eliminate need for very deep pit and expensive foundation.

Minimum Operating Cost

1. *High mechanical efficiency* — stationary spindle design with resulting compact construction, accurate bearing alignment and minimum crank overhang; heavy-duty tapered roller bearings; spiral-bevel and single-helical gearing; circulating oilbath lubrication (supplemented by oil pump in very cold climates and in extremely low-speed operation.)
2. *Short and direct pull rod lines*—small blind angle; installations with no blind angle are possible.

Minimum Upkeep

1. *Low repair and replacement cost* —all parts are designed for long life and are built to stand the wear-and-tear of oil field service: (a) Stationary spindle eliminates heavy loads on housing cover and bolts; (b) Fully heat-treated spiral-bevel and single-helical gearing; (c) Heavy-duty tapered roller bearings—always in correct alignment; (d) Strong steel crank and crank pin; (e) Lubricated case-hardened steel clevis pins and replaceable hardened steel bushings.
2. *Positive and ample lubrication regardless of speed or weather* — specially-designed circulating oilbath system supplemented by oil pump where operating speeds are less than 10 s.p.m. or sub-zero temperatures are common.
3. *Dust, water, and foreign matter cannot enter oilbath enclosure*—housing of oiltight and weatherproof construction with rawhide oil and dust seals.
4. *No expensive belt upkeep*—short V-belt or direct drive.
5. *Easy to inspect, adjust, and repair.*
6. *Requires minimum attention.*

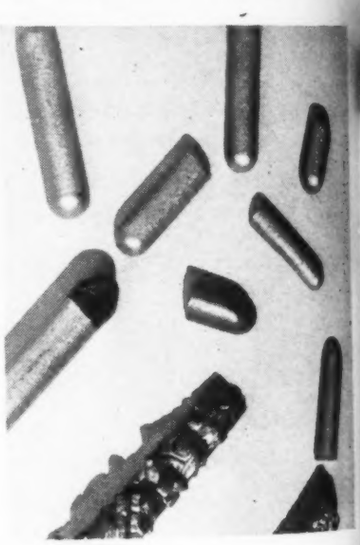
Wide Range of Applications

1. *Choice of drives* — high-speed shaft extension of any desired length supplied for use with short V-belt drive or direct drive.
2. *Choice of prime movers*—horizontal or vertical (multi-cylinder) oil, gas or gasoline engine, or electric motor.
3. *Choice of stroke lengths and pumping speeds*—dual-stroke crank for 30-in. or 36-in. stroke—tapered crank pin shank for convenience in changing stroke length; speeds as low as three s.p.m.
4. *Blind angle can be entirely eliminated*—weather-proof prime mover can be mounted below the plane of the pull rods.
5. *Portable*—of compact, self-contained construction, this power can be lifted from its foundation and moved to a new location with minimum trouble and expense.

New Sizes of Haystellite Inserts

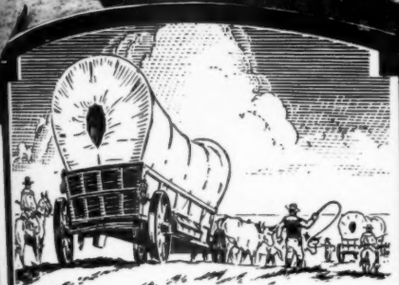
SUPPLEMENTING the present line of Haystellite Inserts, two more sizes of this cast tungsten carbide diamond substitute recently have been made available by Haynes Stellite Company, Kokomo, Indiana. The addition of these two sizes brings the total to thirteen.

Haystellite Inserts, used primarily for hard-setting oil well drilling tools, are



held in place on the cutting and reaming edges of oil well bits by means of a welded high-strength steel binder. The inserts have a special coating so that they will "tin" very easily, assuring an excellent bond with the steel, the makers state. Haystellite protects the tool and assures more footage of out-to-gauge hole because of its extreme hardness and wear resistance, they claim. It not only withstands the abrasive action encountered in hard formations, but, at the same time, is sufficiently strong and tough to resist chipping or crumbling.

UNION Wire Lines "TAME" Kansas Wildcats



When Kansas Helped Tame the Wild West

The period following 1825, Kansas pioneers did their part towards making the West safe for settlement. They found the western prairies overrun by hostile Indians and great herds of buffaloes. In their conquest of the Kansas plains, both men and women showed unfaltering courage.

Buffalo roamed the plains in millions, even down to the decade following the Civil War. In 1868 it required 3 days for General Sheridan and an escort to ride through a single herd, and in the same year a railroad train ran more than 120 miles through an almost unbroken sea of these shaggy beasts.

But the railroad brought hordes of skin hunters who sought buffalo robes for the Eastern market. It is estimated that in one 3-year period 5,000,000 buffalo were killed.

Kansas Leads in Untested Structures!

Kansas has a great future in oil. Already the nation's fourth largest producer, she has more untested structures than any other state. Kansas is rapidly developing new fields, and wildcatting plays an important part on her drilling program.

Right now, an increasing number of Kansas oil men are "taming" their wildcat wells—reducing drilling risks—by using UNION Wire Lines. From experience they've learned that UNION Lines make drilling SAFE!

All through the oil country UNION Lines are setting high standards of dependable performance. They are made by OIL men who make it their business to KNOW oil field requirements.

The photograph was taken at a wildcat well know as Deines No. 1, drilled by J. J. Hall in Trego County, Kansas. Appearing in the picture, left to right, are: Ray Custer, driller; Verl Reff, tool dresser; B. W. Shindhelm, production sup't.; Jess Hunt, Jarecki Mfg. Co.; H. M. Humphrey, Union Wire Rope Corp.

UNION WIRE ROPE CORPORATION

Oil Country Sales Offices: 601 Beacon Bldg., Tulsa, Okla.

Factory and General Office: Kansas City, Mo. Branch: Portland, Ore. Warehouse: Monahans, Texas

In Mexico: E. O. CHAPA. P. O. Box 604, Tampico, Tamps, Mexico. Stocks at Tampico

JARECKI MFG. CO.

Distributors: Midcontinent, New Mexico and Eastern Oil Fields

MARION MACHINE FOUNDRY & SUPPLY CO., Rocky Mountain Fields, except New Mexico

Export Agents: (except Mexico) LUCEY EXPORT CORP. Woolworth Bldg., New York; Broad St. House, London

UNION WIRE LINES

The "ULTIMATE LOW COST WIRE ROPE"

Connecting Flange for Rectorheads

RECTOR Well Equipment Company, Fort Worth, Texas, has added to its line a specially-built connecting flange for use with Rectorheads. This flange provides users of the head perfectly matched threads made on the same templates as the inside threads of the top flange of the head and held to such close tolerances in manufacture that a pressure-tight connection is assured, the manufacturers state.

Made of nickel-chromium forged steel, this flange is tested to 6000 pounds. It is the standard A. P. I. gate valve flange, as to diameter, bolt circle, and

ring groove. Use of the flange eliminates the threaded connection between the nipple and master gate and, due to its matched thread, assures, according to the manufacturer, a pressure-tight connection at the remaining thread. All features found in the Rectorhead are retained, including ability to work the hanger down and the nipple up, even under hazardous conditions, full repackability under pressure, and entire elimination of spools that prevent changing the pipe program in an emergency.

An outstanding feature of the new Rector connection or flange is that its use permits backing out the Christmas-tree in event of trouble during completion or after the well is on production.

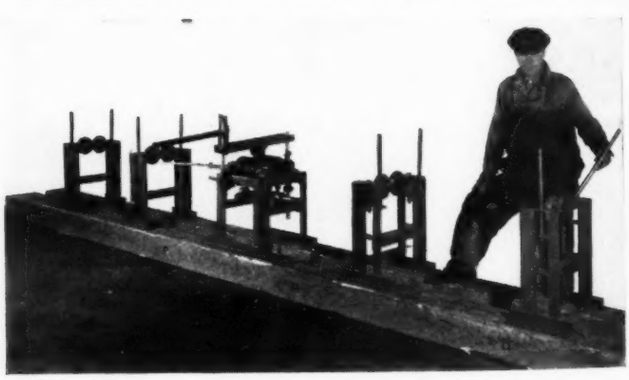
One of the immediate reasons for developing this particular flange for use with Rectorheads is the recent thought given by production men to leaks in threaded connections in casing. Some engineers even have advocated eliminating all threaded connections in the surface fittings, but this would have had to be done as a compromise, sacrificing other values to attain connections fully flanged. Also, it was realized that the "all flanged" hookup would not mean the entire elimination of possible thread leaks, since there are approximately 240 threaded connections in a 7200-ft. oil string. The Rector flange was developed on the basis that thread leaks are more likely to occur when the threads of one manufacturer are connected to those of another, due to A. P. I. allowed tolerance.

Inferno Gauge Cock

THE Inferno Company, Shreveport, Louisiana, is offering a new boiler gauge cock to the oil industry. This new equipment has an 18-8 drop-forged stainless steel body and nozzle that the makers state is non-corrosive. A weighted handle presses a lead disc against the aperture in the stainless steel nozzle. By merely lifting the handle and turning slightly a new seat may be found for the nozzle. This lead disc is reversible so as to afford an unlimited number of seats on either side.

The handle is suspended on a bracket so that when lifted the steam is deflected downward, avoiding the possibility of the operator being burned. The device is recommended for working pressures up to 800 lb., and is factory tested to 1000 pounds. A feature, in addition to interchangeable parts, is a stainless hydraulic grease fitting placed in the side of the bracket so that the mechanism can be greased without disassembling.

New Deal Makes "Pocket Size" Pipe Cleaning Machines

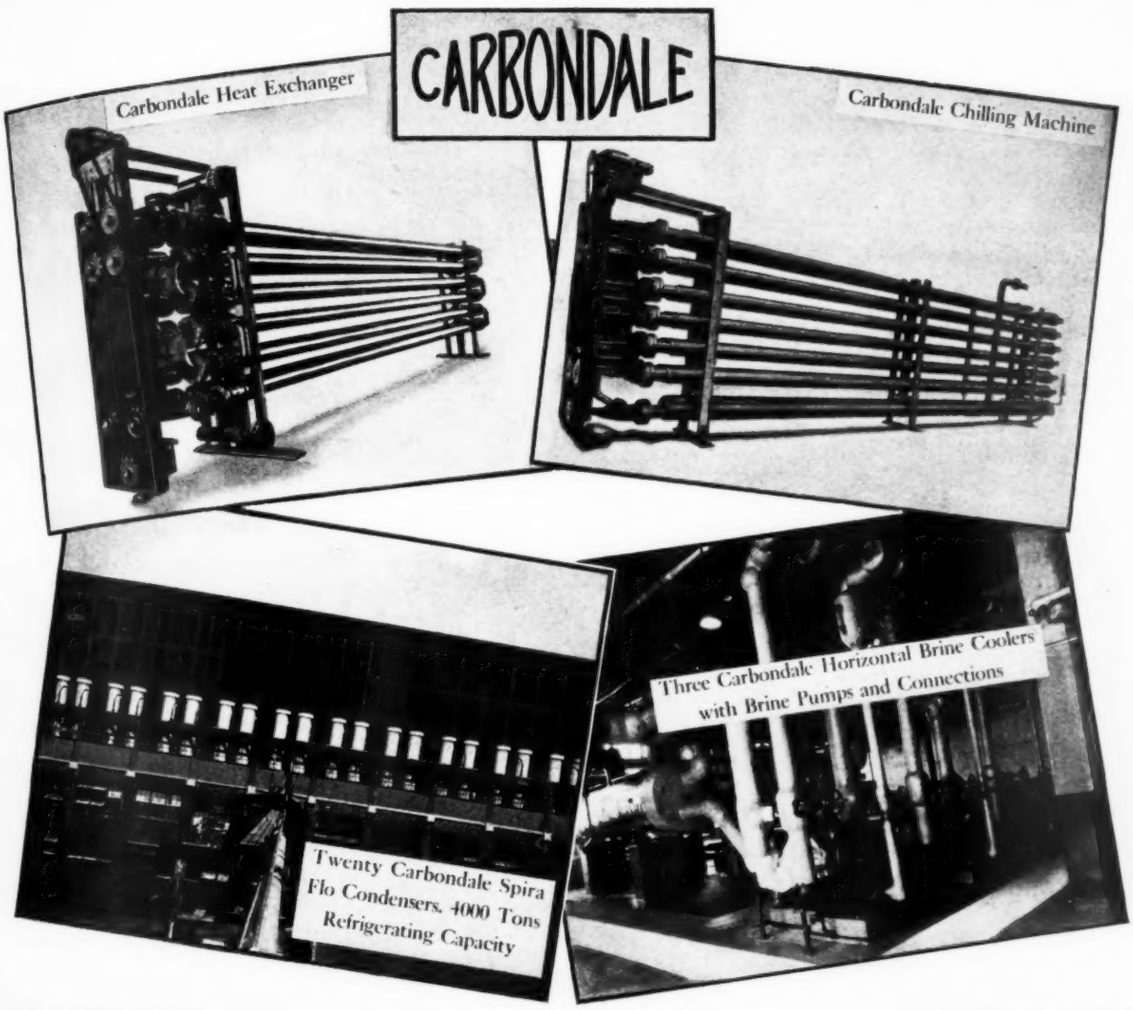


Sturdi-Bilt Series — New Ideal Pipe Cleaning Machine

THE New Deal Specialty Company, Okmulgee, Oklahoma, announce their new Sturdi-Bilt series of pipe cleaning machines, in two models, Sturdi-Boy and Little-Fella. The machines are especially designed for boiler shops, refineries, steam plants, and small pipe yards, for the descaling of small pipe, flues, and conduits.

"Chips" off the old block, the machines are similar in design to the New Ideal Pipe Cleaning Machines, but are smaller in size and capacity. Little-Fella handles pipe up to 4½ in. O.D., and Sturdi-Boy, line pipe up to 4 in., and flues and conduits up to 6⅝ in. O.D.

A feature of the machines is that they can be purchased "as you like 'em," mounted on steel frames, or unmounted for mounting on timbers or concrete. The standard unit contains the cleaning section and four standards with removable safety bars. The guide rollers are bearing mounted, and spring action on one standard, absorbs shock of spinning tubes, and permits easy passage of coupling or weld over the rollers.


CARBONDALE
Carbondale Heat Exchanger
Carbondale Chilling Machine
Three Carbondale Horizontal Brine Coolers with Brine Pumps and Connections
Twenty Carbondale Spira Flo Condensers. 4000 Tons Refrigerating Capacity

1937 MODERN EQUIPMENT 1937 for REFRIGERATION and DEWAXING

COMPRESSION REFRIGERATION SYSTEMS
Single and 2-Stage

ABSORPTION REFRIGERATION SYSTEMS

FILTER PRESSES

Carbondale engineers, with a background of 35 years of refinery refrigeration experience, stand ready to discuss your needs.

Ask for bulletins

CONDENSERS AND BRINE COOLERS

OIL COOLERS AND HEAT EXCHANGERS

CHILLING MACHINES
for Distillate and Solutions

CARBONDALE
DIVISION
WORTHINGTON PUMP AND MACHINERY CORPORATION

CAT.-7

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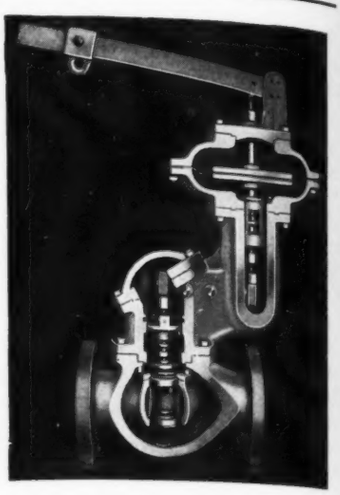
Perfected New Types of CBV Gas Regulators Extend "Reliance" Line

RELIANCE Regulator Corporation Division of American Meter Company announces a new line of gas regulators featuring an improved combination balanced valve (CBV) unit on which Reliance engineers have been working for some time.

The new line offers numerous interesting features, including interchangeability of parts, a unit construction that facilitates any necessary repair, reduced motion and friction, and greater accuracy in regulator control.

A full range is presented of lever-weighted, spring-loaded and pilot models of both offset and direct-connected types; either reducing or back-pressure regulators, affording many different combinations in assembly. Standard sizes, from the straight 2-in., 3-in., 4-in., up to 10-in., shortly will be available; the smallest orifice throat being 1¼-in. in diameter. All bodies are the same, for high- or low-pressure service.

For convenience, the regulators are designated as high-pressure type units. The only differentiation for low-pressure construction is where semi-low or low-pressure enclosed dead-weight diaphragm head exists and where bearing pins are installed so as to give a 3.4 to 1 level pressure, as compared with pin installations in the center hole to produce a 1 to 1 power ratio for the high-pressure units. Change from high- to low-pressure service is easily effected.



Any possibility of surging and pulsation is eliminated by means of a special stabilizer that is part of the standard new regular equipment, except on the low-pressure units—boiler fuel, motor valve, etc., the manufacturers state.

The offset types have the rocker arm—connecting valve stem to diaphragm valve—equipped with oilite bushings and stainless steel rockers, so designed and adjusted as to prevent any lost play whatever in movement.

All diaphragm heads are interchangeable on any size, of both offset and direct-connected types. Only three different sizes of bolt and cap screws are used on the whole job; there can be no confusion or mistake when a regulator is taken apart for repairs, the makers point out.

Cover plates on upper diaphragm chamber also are interchangeable, it being a simple matter to convert from weight to spring-loaded or to pilot-loaded type.

Offset type units connected on the 1 to 1 power ratio have exactly the same power as the direct-connected units, but give the further advantage of quick accessibility to the valve mechanism through a hand-hole plate. All the mechanism is speedily removable through the top, and installations made in pits, vaults, etc., are readily accessible. Nor are there right- or left-hand bodies to entail expense. (Valve mechanism of the direct-connected units also is removable).

Valve stem, valves, cage, etc., may be removed as a single unit, and, if new

NEVER A
CRATER
on a
RECTORHEAD
EQUIPPED WELL!
We don't say that it can't happen, but the fact remains that not one of the thousands of wells equipped with RECTORHEADS has been lost. RECTORHEAD users are careful in selecting all of their equipment, and careful in their operations. RECTORHEAD design permits the handling of serious problems when unexpected trouble arises. The full opening body prevents cutting by sand blow. Drilling hazards are minimized because the well does not have to be opened before or after running pipe. And RECTORHEADS are repackable under highest well pressures.
See Page 1439, your 1937 Composite Catalog
"Sold Through Supply Stores"
RECTOR WELL EQUIPMENT CO. INC.
FORT WORTH, TEXAS
WICHITA FALLS
MIDLAND
TULSA
SHREVEPORT
HOUSTON

valve seats are needed, the complete assembly can be sent to the repair shop while a spare assembly replaces the original unit. Seldom is it necessary to remove the body proper from the line.

The two-part valve stem, connected with ball and socket joint, allows no vertical play and, should any foreign matter lodge under valve and seat, permits of simple alignment. Likewise, easy alignment is afforded if assembly during repairs is not exactly true.

Main body castings all are tapped at the bottom and usually plugged, except in the boiler-fuel regulator, in which an adjustment screw can be set, to keep the valves from complete shut-off. Thus the burners are supplied with sufficient gas to keep them lighted at all times; or, if a complete lock-up is desired, the adjustment merely can be backed off.

All valve stems are of stainless steel, with forged-steel valve seats, bronze guides, and cast-iron cage. Gasketed surfaces are recessed and grooved, so that all gaskets hold their true alignment.

Lever-weighted models support the lever on a self-centering pin. There are four holes in the lever support, cast to the top cover. Two are used with reducing regulators, the outside top hole for 15-in. and 11-in. diaphragm heads, and the inside top one for 9-in. and 7-in. heads. The lower holes are used for back-pressure units, and for the same size heads.

On the spring-loaded models, a non-rising screw adjustment is employed. The adjustment screw opening therefore can be capped—and sealed, if desired.

Any of the high-pressure regulators can be equipped with 7-in., 9-in., or 11-in. diaphragm head. A 15-in. diaphragm head, which will handle lower pressures of from 6 in. to 2 lb., also is obtainable. A complete range of pressure springs can be provided. The low pressure dead weight head is capable of giving outlet pressures up to 12 in. of water, and the semi-low (with outside weight only) outlet pressures up to 42 in. of water.

Weld Strength of 100,000 Lb. Per Sq. In.

WELDS with tensile strengths of approximately 100,000 lb. per sq. in. can be made with the new "Shield-Arc 100" electrode announced by The Lincoln Electric Company of Cleveland, Ohio.

"Shield-Arc 100" electrode is a heavily-coated electrode of the shielded-arc type. It is designed for welding steels having somewhat higher ultimate strengths than those ordinarily welded with Lincoln "Shield-Arc 85" electrodes. Welds produced by the new electrode in the higher tensile steels possess ultimate strength of 100,000 to 105,000 lb. per sq. in. as welded. In the as-welded condition, ductility of welds is from 12 to 18 percent elongation in two inches.

It is obvious that the chemical composition of the plate being welded will affect the tensile strength and ductility of the weld. When deposited in mild steel plate, the weld metal will have a tensile strength of approximately 100,000 lb. per sq. in., yield point of 85,000 to 95,000 lb. per sq. in., and ductility of 12 to 18 percent elongation in two in. in the as-welded condition. When stress-relieved, the welds possess ultimate strength of 110,000 to 115,000 lb. per sq. in., yield point of 95,000 to 105,000 lb. per sq. in., and ductility of 18 to 22 percent elongation in two inches.

"Shield-Arc 100" electrode is suitable for flat, vertical, and overhead welding and is available in 1/8-in., 5/32-in., and 3/16-in. sizes. For most vertical and overhead welding the 1/8-in. and 5/32-in. sizes are preferred; however, the 3/16-in. size may be used for making vertical welds in thick plate.

PREDICTION

For the same reason that men would rather press a button for light than fill a bowl, trim a wick, polish a chimney and light a match . .

For the same reason that men use the telephone, the telegraph, the wireless and the mail service rather than send messages by courier .

For the same reason that business men use typewriters instead of quills and carbon paper instead of duplicators . . . . . .

For the same reason that people prefer mile-a-minute streamlined trains to the lumbering coal-dusters of yesteryear . . . . . .

. . . for these and other equally obvious reasons the Oil Industry will purchase more Electric Power in 1937 than in any previous year.

PURCHASED ELECTRIC POWER

PETROLEUM ELECTRIC POWER CLUB

"Clipper" Model, Toolpusher Type Weight Indicator

THE new "Clipper" multiplex toolpusher type weight indicator, announced by Martin-Decker Corporation, Long Beach, California, was designed for those operators desiring a unit type of weight indicator. The "Clipper" provides the ultimate in accuracy, sensitivity, and ruggedness, its makers state. It is the result of months of painstaking designing and experimenting, utilizing in its construction only those sound, well-founded principles that have been developed over a period of many years.

The "Clipper" is a self-contained, readily-portable weight indicator that is calibrated at the factory and arrives at the rig ready to attach to the dead line. It requires no further pumping up or adjusting and, regardless of hot weather or cold, will always provide the same sensitive, accurate readings, it is stated.

The "Clipper" is essentially an instrument for those not requiring or desiring a chart record. It is especially adaptable to drilling conditions where installation time is a factor. Urgent need for such a design usually exists in shallow territories, in all production work, such as handling rods and tubing, setting packers, liners, etc., in the handling and especially in the pulling of casing with cable tools; in emergency fishing jobs and all sorts of drilling operations, providing, in fact, what the name implies—an instrument that can be carried from well to well by the toolpusher and can be quickly installed on any drilling or production job.

As a result of the unique design, all projecting parts, such as hinges, hasps, rings, etc., either have been eliminated or streamlined, thus precluding the possibility of tong lines or cat line becoming fouled on the instrument.

The "Clipper" is an extremely rugged instrument, weighing but 47 lb., with the weight concentrated close up to the dead line. The maximum dimension is 13 in.; the thickness seven inches. Light weight and close dimensions practically eliminate the tendency for this type of instrument to swing while on the line.

The aluminum gauge case is made waterproof; tubing is connected solidly through the back of the case to the diaphragm by means of special fittings; the thin shatterproof glass is set behind a streamlined gauge ring in a molded rubber gasket, which is "U" shaped in cross-section, all held securely in place by six heavy gauge ring screws.

The dial faces are non-glare and are etched with a design of numeral that is clear and distinct. While the "Clipper" is an outstanding example of compactness, there has been no sacrifice made to the size of the gauge dial. These two factors are of great importance because the toolpusher instrument is usually placed on the opposite side of the derrick floor from the driller. Easy visibility and readability, then, are very important.

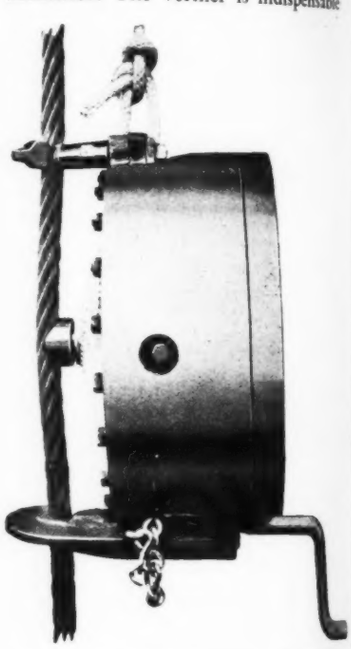
Fluid, of course, is used as a means of operation because it provides a positive, accurate, controllable means of converting the tension in the dead line to lb. load on the hook or derrick. The fluid used in the "Clipper" is non-freezing, capable of withstanding temperatures considerably lower than 40 deg. fahr. below zero, and is non-corrosive.

No outside tubing connections or filling means are provided. The instrument is vacuum-loaded at the factory with the exact amount of fluid necessary. After filling, it is subjected to pressures far in excess of those that will be encountered in actual service and left under test for six days. Only after the finished weight indicator has withstood successfully this pressure test is it shipped. It is then ready to render long, accurate service on the rig without the necessity of refilling, say the manufacturers.

The "Clipper" provides two methods of load indication: one showing the load in points, as previously used on the Martin-Decker weight indicator, and the other method providing the operator with load readings directly in thousands of pounds. This is accomplished by the use of quickly interchangeable calibrated dial rings that read directly in thousands of lb. load. Ten of these calibrated dial rings are provided with each instrument, covering the various combinations of line "strings" for 1-in., 1⅛-in., and 1¼-in. drilling lines. The multiple dial system is used because it is utterly impossible for a single direct reading dial to provide accuracy under all conditions of line strings and different types and sizes of lines, it is stated. The dial rings are nested at all times in the waterproof case, where they are protected from damage or loss, and are easily removable without the necessity of removing the gauge hands. This avoids disturbing the calibration of the gauge.

Weight indicator points are shown on the outside of the gauge ring and for those drillers not accustomed to reading the dead line load in thousands of lb. makes points to lb. conversion simple.

The "Clipper" is equipped with the super-sensitive vernier, which is six times as sensitive as the regular weight indicator. The vernier is indispensable



when it becomes necessary to drill with light weights or on fishing jobs.

Both the vernier and the weight indicator are provided with sensitivity controls that may be regulated by the driller to provide the sensitivity required. For example, rough drilling will cause the hands of a sensitive weight indicator to overthrow. The driller may adjust the action of the "Clipper" to eliminate this overthrow and make the weight indicator readable.

A simple safety device eliminates the possibility of the instrument being accidentally disengaged from the dead line by a sudden jerk caused from slack being thrown in the line or when jarring on casing, etc.

With its compact light weight, the "Clipper" is easily installed and readily portable. A light steel case can be supplied that provides protection in transportation and storage.

J. & S. Gas Mixing Valve

THE J. & S. Carburetor Company, Dallas, Texas, announces the J. & S. Gas Mixing Valve, use of which, the manufacturers state, provides automatically the correct proportion of gas and air for all loads. Air is admitted from all sides into the cup-shaped piston, creating a turbulent zone through which the gas must pass

before entering the engine. In so doing, it is thoroughly mixed with the air. The velocity of the air entering remains practically constant regardless of the load on the engine. The air inlet, extending entirely around the valve, produces a balanced effect, eliminating side drag on the piston and resulting in its being sensitive to the slightest variation in the load demand on the engine.

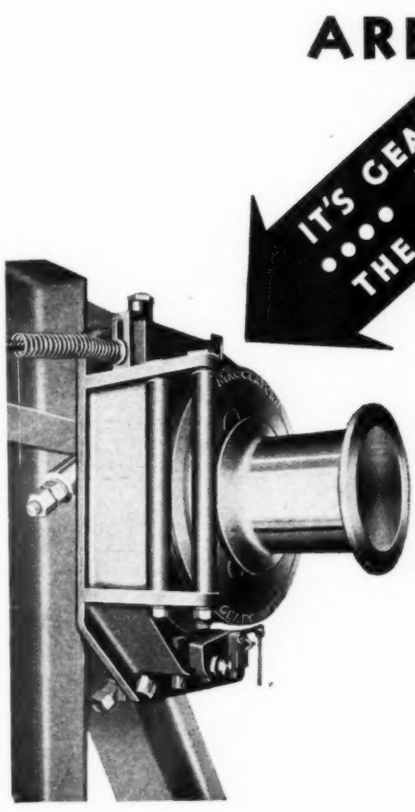
The floating piston shifts laterally against gas inlet port, closing it when the engine stops. The bridges across the air port in the piston are set back from the surface, so the valve, in closing, does not have to shear off the accumulation of dust. It therefore makes for very reliable operation in closing when the engine stops, the makers point out. This construction also permits starting without priming the engine with gasoline.

In case remote control or automatic operation is required, a Startix or Synchro-Start may be used for starting, the ignition switch being controlled either thermostatically, by a float switch, or pressure-operated means, depending upon the duties of the engine.

The valve is easily dismantled for inspection and cleaning. But one adjustment is required, and this can be made instantly without tools. This is important in instances where the quality of the gas changes often. The changeover from natural gas to butane, for instance, can be made almost instantly.

This Picture Shows You . . .

WHY MacCLATCHIE GEAROMATIC CATHEADS ARE BETTER



The Only Modern Cathead for Modern Deep Drilling and Tight Joints

Every Superintendent, tool pusher, and roughneck using the MacClatchie Gearomatic Cathead says it is superior to any other joint breaking device they have ever used.

•

There is one outstanding reason why each MacClatchie Tool gives better service. This is one of a series of ads telling WHY.

It's geared 2 to 1. Double the power at half the speed permits running the line shaft slower, causing a slow, steady pull which breaks even the tightest tool joints easily — 8″ joints included.

An absolutely positive kick-out permits the MacClatchie Gearomatic Cathead to make but one pull, eliminating any fouling and giving the utmost in safety.

There is no friction clutch nor costly bearings, hence lower maintenance cost. Simple lubrication is made possible through one Alemite nipple.

MacClatchie Mfg. Co.

COMPTON, CALIFORNIA — HOUSTON, TEXAS

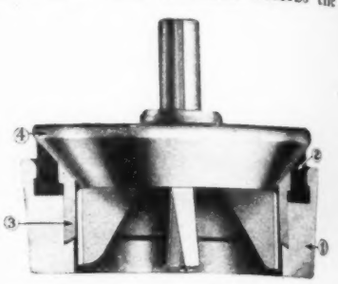
Export: GEO. R. WOODS, 17 Battery Place, New York City

Twin-Seat Valve

CERTAIN advantages are claimed by the manufacturers for the Twin-Seat Valve for slush pumps, made by the Twin-Seat Company, of Houston, Texas, and distributed by W-K-M Company, Inc., of the same city. The equipment is called a Twin-Seat valve because of the combination rubber and steel seats, both of which seat into a non-corrosive, acid-resisting bronze body that fits securely into the deck of the pump. All wear is thrown onto the rubber and steel seats, which are easily replaceable. This eliminates the replacement of the bronze seat body, effecting an economy, the manufacturers state.

The makers further point out that Twin-Seat Valves eliminate the necessity of continually pulling the seat from the deck of the slush pump, avoiding damage to the latter. Only the rubber and steel insert seats are changed. Leaving the bronze seat stationary not only avoids damage to the pump deck, but eliminates also possible damage from frequent pulling or cutting out with a torch, and replacement of mud ends from these causes becomes an unknown factor, it is pointed out.

Twin-Seat Valves provide two positive leak-proof seats on the valve body inserts, it is stated. The first seal is on the rubber insert, which absorbs the shock and compresses until the valve is fully seated and cushioned on both rubber and steel. This avoids pounding.



(1) Bronze valve seat body, which serves as a container for the rubber and metal insert seats. (2) The rubber insert seat acts as a seal and shock-absorber for the replaceable steel insert seat. (3) The steel insert seat is drop-forged from a high-grade nickel steel, and is heat-treated. (4) The valve is made in one piece, is drop-forged from a high-grade carbon steel, and heat-treated

The valve itself is a one-piece drop-forging, heat-treated. The steel insert seat also is drop-forged and heat-treated.

Oxweld Announces Three Regulators

A SERIES of three new regulators providing accurate oxygen and acetylene regulation through the entire range of welding and cutting operations has been announced by The Linde Air Products Company, 205 East 42nd Street, New York, N. Y. All three regulators are of two-stage construction, essentially identical in basic design, and offer the utmost in precise, efficient pressure control, the manufacturers state.

The Oxweld Type R-64 oxygen regulator is designed to operate with extreme precision in all welding and cutting operations requiring oxygen pressures up to 75 lb. per sq. inch. The Oxweld Type R-65 oxygen regulator is designed for heavy-duty cutting operations, which may require oxygen pressures as high as 200 lb. per sq. inch. As the sensitivity of adjustment and precision of operation carry throughout its entire pressure range, it also can be used for welding, should the need arise. The Oxweld Type R-66 acetylene regu'ator is a companion piece for either of the oxygen regulators and will give accurate acetylene regulation for all welding and cutting operations.

The attractive, streamlined appearance of these regulators gives visual

To the oil and gas industry Fluor offers three products — one service. The three products are: Aerator Type Cooling Towers, Air-Cooled Mufflers and Gas Cleaners.

In the capacity of oil country engineers and constructors, over a period of forty-four years, the Fluor Corporation has satisfied every technical demand. In the development and acceptance of its three products, Fluor has made tangible contributions to the industry's operating efficiencies and economies. Your request for further information will receive prompt attention.

The Fluor Corporation, Ltd.—909 E. Fifty-Ninth St., Los Angeles Calif. . . 30 Church St., New York City . . 909 McCormick Bldg., Chicago . . 703 Fairfax Bldg., Kansas City . . 719 McBirney Bldg., Tulsa . . 1406 Esperson Bldg., Houston.

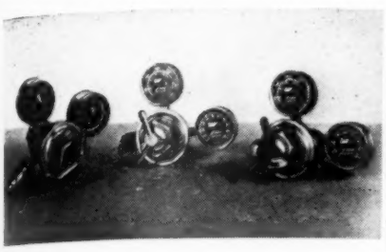
BE SURE WITH FLUOR

FLUOR

OIL COUNTRY ENGINEERING & CONSTRUCTION
AERATOR TYPE COOLING TOWERS
AIR-COOLED MUFFLERS
GAS CLEANERS

evidence of the modern design principles that have been employed throughout in their construction.

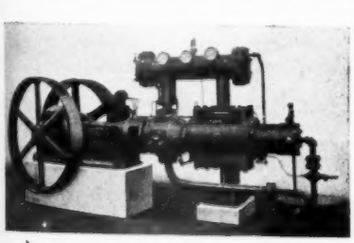
There are several outstanding details of design that are of particular importance to any one using welding and cutting apparatus. The valves are stem-



operated and close with the incoming pressure, not against it. Sensitive rubber diaphragms and self-contained first-stage valves are important improvements. The bodies and caps are pressure forged to insure adequate strength. The dials of the pressure gauges are colored and the calibrations are silvered, thus making them exceedingly easy to read. The point of the pressure-adjusting screw is cradled in three ball bearings to preserve exact alignment and provide fingertips regulation through its full range. The handle of the adjusting screw is tri-spoked to provide an effective grip for obtaining sensitive adjustment of the delivery pressure. The regulator bodies are finished with a durable lacquer, green being used for oxygen and red for acetylene.

Horizontal 3-Stage Compressors by Worthington

AN improved line of single horizontal 3-stage compressors for pressures from 750 lb. to 2500 lb. is



now offered by Worthington Pump and Machinery Corporation, Harrison, New Jersey. These compressors are particularly well suited for higher pressures, since the compression cylinder requires only one packing box, which is subjected solely to moderate pressures, the makers claim. Leakage is thus reduced to a neglible and controllable factor. This feature is especially desirable when compressing valuable or inflammable gases.

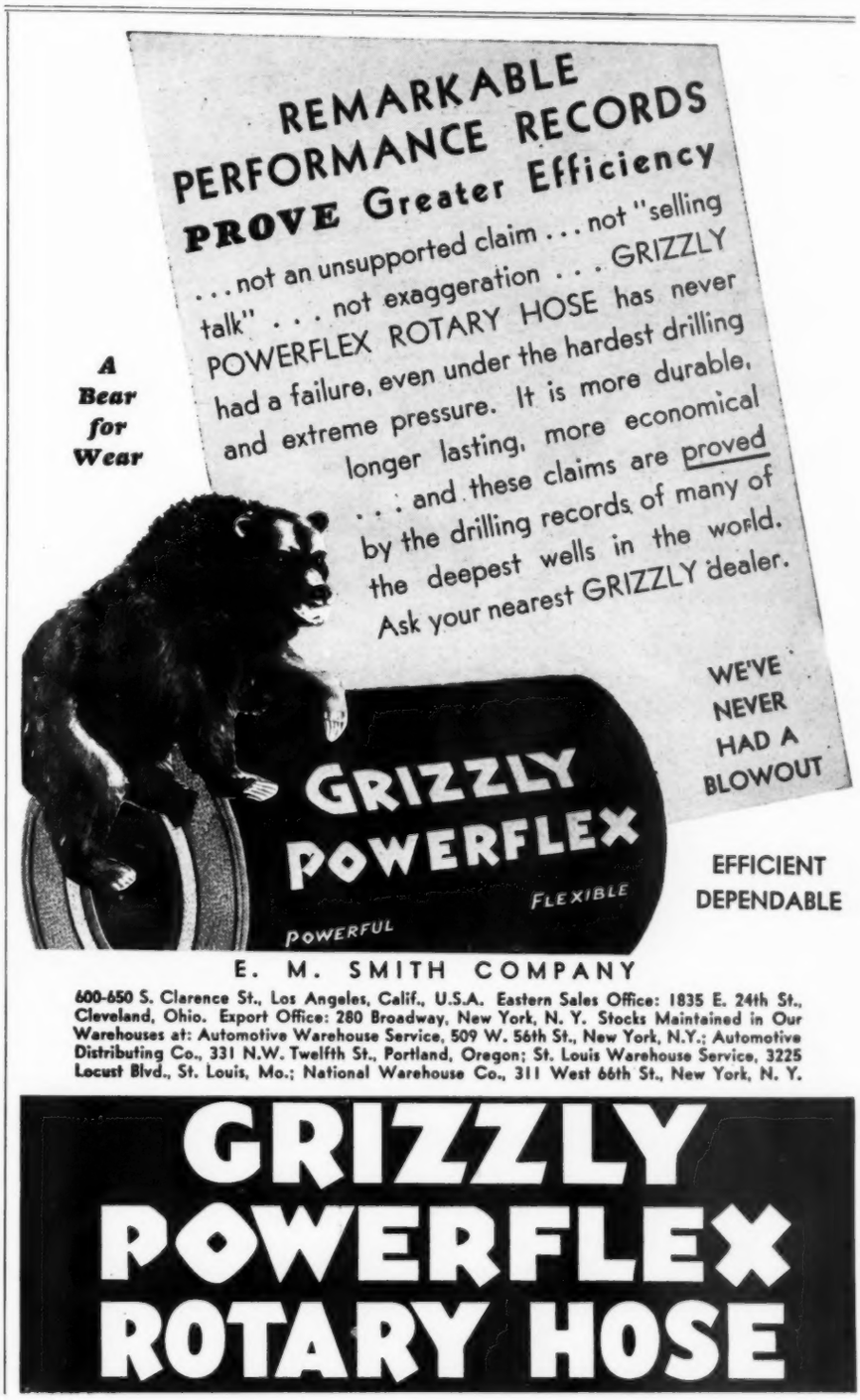
The compressor is applicable to any high air-pressure service, also for the compression of oxygen, hydrogen, helium, and other special gases, as well as refinery gas or straight natural gas.

Double-row tapered-roller bearings, automatic self-oiling frames with oil-tight covers, Worthington feather and ring plate valves, and efficient intercooling between stages are features of this improved line of compressors. A choice of steam or motor drive is offered on all sizes.

Bulletin L-611-B12, obtainable upon request to the manufacturer, shows a sectional view of a compressor and gives detailed specifications.

Fouts Company Receives Derrick Account

Humphrey Steel Products Company, Dallas, Texas, announces the appointment of The Fouts Company as exclusive sales representative for the Humphrey diamond-type steel oil derricks, with headquarters at 602 Burt Building, Dallas, Texas. Derrick stocks will be carried at Kilgore, Corpus Christi, and Odessa, Texas; Shreveport, Louisiana, and Tulsa, Oklahoma.


REMARKABLE PERFORMANCE RECORDS PROVE Greater Efficiency
. . . not an unsupported claim . . . not "selling talk" . . . not exaggeration . . . GRIZZLY POWERFLEX ROTARY HOSE has never had a failure, even under the hardest drilling and extreme pressure. It is more durable, longer lasting, more economical . . . and these claims are proved by the drilling records of many of the deepest wells in the world. Ask your nearest GRIZZLY dealer.
A Bear for Wear
WE'VE NEVER HAD A BLOWOUT
GRIZZLY POWERFLEX
POWERFUL
FLEXIBLE
EFFICIENT
DEPENDABLE

E. M. SMITH COMPANY

600-650 S. Clarence St., Los Angeles, Calif., U.S.A. Eastern Sales Office: 1835 E. 24th St., Cleveland, Ohio. Export Office: 280 Broadway, New York, N. Y. Stocks Maintained in Our Warehouses at: Automotive Warehouse Service, 509 W. 56th St., New York, N.Y.; Automotive Distributing Co., 331 N.W. Twelfth St., Portland, Oregon; St. Louis Warehouse Service, 3225 Locust Blvd., St. Louis, Mo.; National Warehouse Co., 311 West 66th St., New York, N. Y.

GRIZZLY POWERFLEX ROTARY HOSE

Announces Appointments

The Lincoln Electric Company, Cleveland, Ohio, announces that Robert Daniels has been placed in charge of the Chattanooga, Tennessee, office of the company, situated at 1015 Hanover Street. Daniels has been associated with the company in sales work since April, 1934.

The company also announces the appointment of William F. Fischer to the sales staff of its San Francisco office, 866 Folsom Street.

"Caterpillar" Forms Central Sales Division

Caterpillar Tractor Company, Peoria, Illinois, announces the appointment of Louis B. Neumiller as sales manager of its Central Sales Division. Edw. W. Jackson has been promoted to general service manager, the position held by Neumiller prior to his advancement.

The Central Sales Division includes roughly the territory lying between the Rocky Mountains and the Mississippi River.

COOK'S GRAPHITIC IRON PISTON RINGS *increase engine life!*

AN INTERNATIONALLY PROMINENT COMPANY* found the ratio of cylinder wear in their Diesels unduly high. Something had to be done...

THE PROBLEM—The necessity of increasing engine life (reducing cylinder wear) without resorting to very expensive and impracticable changes in equipment and operation.

SOLUTION — Replacement of the ordinary rings used, with COOK'S GRAPHITIC IRON Plain Rings in combination with COOKTITE Sealing Rings, as suggested by our engineers.

RESULTS—Comparative operating data compiled over a period of years before and after making the change show an average increase in engine life of 230%.

This is only one of many hundreds of cases of record where operating and maintenance costs were substantially reduced, in both new engines and engines in service, by the installation of COOK'S Rings.

The application of COOK'S Rings may prove highly profitable in your engines. You can find out by sending us the performance characteristics of your engine. It will pay you!

*Name on request.

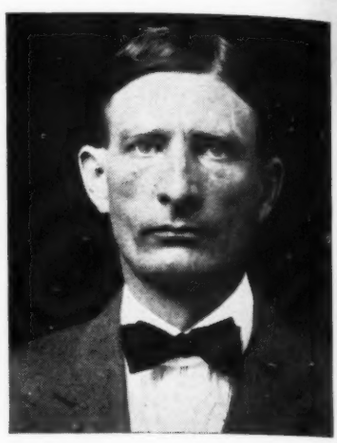
C. LEE COOK MANUFACTURING CO.

INCORPORATED

New York Cleveland Baltimore Los Angeles LOUISVILLE, KY. Chicago Tulsa San Francisco New Orleans

J. G. "Jim" Stroup

J. G. "Jim" Stroup, of the production department of the Phillips Petroleum Company, died recently at Pampa, Texas. He first became connected with the oil industry at the age of 15 years, after finishing high school in Bradford, Pennsylvania, and first worked for his father, J. S. Stroup, who at that time was superintendent of the McCallimate



J. G. "JIM" STROUP

Oil Company, which had large holdings in the old Bradford, McKean County, Pa., field. From there the family moved to Montpelier, Indiana, where he worked as a cable tool driller. In 1907 he went to Bridgeport, Illinois, at the opening of the oil excitement there. Shortly thereafter he made his first trip on foreign service to Burmah, India, where he was engaged as a driller with the Burma Oil Company for five years. He returned from Burmah in 1912, and immediately signed for work in Venezuela.

Returning to the United States the following year he went to Bartlesville, Oklahoma, where he worked as a driller for Phillips Petroleum Company until 1915, when he became connected with the Boggs Drilling Company. Later he made another foreign trip, working first in the Trinidad fields, British West Indies, and later in Venezuela. Returning to the United States in 1918 he formed, with Hal Gruber (now vice-president and sales manager of the Union Wire Rope Corporation) the Tiduoute Drilling Company, doing contracting work in Oklahoma for the Phillips Petroleum Company.

After selling out in 1927 he then pushed tools for Hinerman Bros. until the following year when he went to Calgary, Alberta, Canada, for the Hudson's Bay Oil and Gas Company. Because of his wife's ill health he was there only a year, going to Pampa, Texas, in 1928. From that time he had been employed by Phillips Petroleum Company.

"Jim" Robinson Promoted

With the beginning of the new year, J. I. Robinson assumed the office of vice-president of Crane, Ltd., Canada. He succeeded J. Austin Murphy, who has retired from active service after 51 years with the company.

"JIM" ROBINSON

Robinson joined Crane Company in 1907 in the San Francisco branch. In 1919, when the company started its Canadian expansion, he was transferred to Montreal where he worked his way up to the position of director and general sales manager. From this position he now steps up to the office of vice-president with complete supervision over Crane, Ltd., and its subsidiaries.

Dresser Promotes

Changes effective January 1, 1937, in the personnel of the S. R. Dresser Manufacturing Company, of Bradford, Pennsylvania, manufacturers of flexible pipe couplings and pipe line repair devices, include the elevation of M. N. Davis from vice-president in charge of sales to executive vice-president. Davis also continues as secretary of the company.

H. N. MALLON

H. P. Boncher, formerly assistant sales manager, is now sales manager. The new assistant general manager is R. E. Reimer, who takes on this new position in addition to his duties as treasurer. H. N. Mallon continues as president and general manager.

M. N. DAVIS

Bethlehem Steel Acquires Taubman Supply Co.

Bethlehem Steel Corporation, on January 1st, acquired the Taubman Supply Corporation, it has been announced by Bethlehem's president, E. G. Grace. The name of the company has been changed to the Bethlehem Supply Corporation, and headquarters are in the National Bank of Tulsa Building, Tulsa, Oklahoma. Herman P. Taubman is in charge of the Bethlehem Supply Corporation as executive vice-president and general manager. All officers of the Taubman Supply Corporation retain their former positions.

In addition to its headquarters in Tulsa, the company has a district office and main distributing plant at Houston, Texas, a district office at Dallas, and one at Wichita, Kansas. These will continue under the same management with enlarged space and personnel.

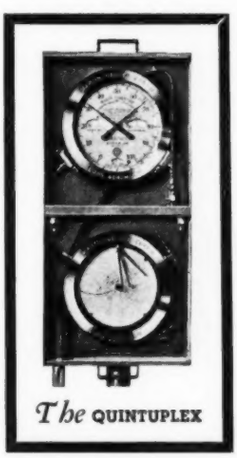
Stores are situated at Corpus Christi, Houston, Monahans, Borger, and Willow Springs, Texas; Tulsa, Oklahoma City, Seminole, and Ada, Oklahoma; McPherson, Chase, and Russell, Kansas; and one is now being constructed at Rodessa, Louisiana.

Machine shops are maintained at Houston, Willow Springs, Borger, Tulsa, Oklahoma City, Seminole, and McPherson.

~~PERFECTION~~

PROGRESS

● There is no such word as perfection in the Martin-Decker vocabulary—with us it is *progress*. Each succeeding development, field tested and proved, that becomes a part of any Martin-Decker Instrument is only a stepping stone towards a still greater and more beneficial improvement.



The QUINTUPLEX

The Martin-Decker "QUINTUPLEX" Drilling Control Instrument is a high mark in this field of progress—a dependable, accurate instrument which covers every phase of the drilling operation, on the shallowest or deepest wells, with accuracy and sensitivity. Weight on bottom, load on derrick, slush pump pressure, torque in drill pipe and rotary table speeds are all shown on one 12-inch dial. Five individual units are installed in one case: each one providing the driller with necessary information for complete control. A single recording gauge records weight, torque and mud pressures on one extra large chart, thus eliminating the installation and maintenance of several recording gauges.

The "QUINTUPLEX" and its uses are described in the New Booklet, *"Drilling Control."* You are welcome to it, write to

THE WEIGHT INDICATOR

MARTIN DECKER CORP.

LONG BEACH CALIFORNIA

San Joaquin Valley: A. F. McQUISTON, Bakersfield, California
Mid-Continent Distributor: REED ROLLER BIT COMPANY, Houston, Texas

NATIONAL BANK OF TULSA

TULSA, OKLAHOMA

STATEMENT OF CONDITION
December 31, 1936

RESOURCES

Cash and due from Banks	$22,463,399.16	
U. S. Government Securities	18,551,884.91	
Other Bonds and Warrants	6,598,659.60	$47,613,943.67
Loans and Discounts		14,080,067.55
Overdrafts		853.77
Income Receivable Accrued		182,143.90
Stock in Federal Reserve Bank		210,000.00
Investment in Bank Premises		2,296,000.00
Customers' Liability under Acceptances		8,205.00
TOTAL		$64,391,213.89

LIABILITIES

Deposits		$56,870,480.59
Acceptances Executed		8,205.00
Income Collected, Not Earned		63,933.24
Interest, Taxes, etc., Accrued		79,172.82
Reserve for Preferred Dividend		52,500.00
Capital—Preferred	$3,000,000.00	
Capital—Common	2,000,000.00	
Surplus	2,000,000.00	
Undivided Profits and Reserves	316,922.24	7,316,922.24
TOTAL		$64,391,213.89

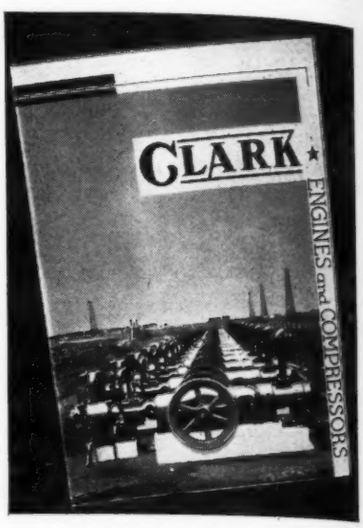
COMPARATIVE DEPOSITS

December 31, 1933	$28,016,837.43
December 31, 1934	37,292,321.66
December 31, 1935	46,600,899.11
December 31, 1936	56,870,480.59

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

New Catalog on Clark Engines and Compressors

Clark Brothers Company, of Olean, New York, have just issued an attractive new catalog, and announce that copies are available upon request.



The new catalog presents the company's line of stationary compressors for Diesel engine, gas engine, steam engine, and electric drive, portable engine-driven compressors, drilling and pumping engines, and vertical natural gas engines for driving generators.

It especially features the company's new "Super 2-Angle" compressor, a design that places the power cylinders at right angles to the compressor cylinders, in the interest of compactness and reduction in foundation area.

STRAIGHT TALK.... *about* CROOKED HOLES

Write for literature

SPERRY-SUN WELL SURVEYING CO.

1608 Walnut Street, Philadelphia, Pa.
425 Petroleum Building, Tulsa, Okla.
3118 Blodgett Avenue, Houston, Texas
549 East Bixby Road (3800 Block—Atlantic Ave.) Long Beach, Calif.

Addition to G-E Building at Dallas

A three-story concrete and brick addition to the General Electric building at Dallas, Texas, will be constructed immediately, according to an announcement made by the General Electric Company.

The new structure will adjoin the office and warehouse building now at the corner of Lamar and Corbin Streets, and will provide all departments of the company with permanent headquarters in Dallas. It is expected that construction will be completed about June 1.

The design and construction of the new building is under the supervision of the engineering department of the General Electric Realty Company of Texas. Architects in charge of the plans are Lang and Witchell, of Dallas.

Pomona Pump Opens New Plant at St. Louis

A complete and extensive new plant for the manufacture of Pomona Turbine Pumps and service to distributors is now in production in St. Louis, Missouri. According to W. H. Day, vice-president, the year 1936 closed with sales records at the highest total in the history of the company. Additions have been made at the home plant in Pomona, California, during depression years, but to supplement adequate production, it has been necessary to establish a central location to provide faster deliveries to eastern states, Day states.

The new plant is completely equipped and will be operated in connection with the factory at Pomona, California. The location at 4301-7 South Spring Avenue, St. Louis, was selected due to the excellent facilities for transportation by rail, and motor highways radiating in every direction, connecting with all points north, east, and south. Overnight deliveries are now possible to all points within a radius of 300 miles, and in 48 hours or less, goods can be laid down anywhere east of the Rocky Mountains, Day says.

C. C. Cook, former manager of Pomona's Chicago office, has been appointed St. Louis manager. He will be assisted by a staff of competent engineers, production superintendents, and skilled workmen thoroughly trained to Pomona standards at the factory in Pomona.

E. W. Bennison succeeds Cook as manager of the Chicago office.

Adds Manufacturing Division

Nowery J. Smith Supply Company, 3610 McKinney Avenue, Houston, Texas, has added a manufacturing division and is now completing erection of a steel plate and structural plant for the fabrication of its oil and gas separators, steel derricks and derrick accessories, pumping units, and welded tanks. These products will be carried and sold by the Nowery J. Smith Supply Company's branches in the Gulf Coast fields, at Shreveport and New Iberia, Louisiana, and Houston and Corpus Christi, Texas.

J. E. Wilkerson, formerly chief engineer of the Emsco plant, will be in charge of plant operations, according to E. J. Broberg, sales engineer, and will employ around 15 skilled employes.

PUMPING for PROFIT !

When oil sold for several dollars a barrel JENSEN had in mind the lean years, when dollar oil would make pumping for profit a real problem.

Which explains the fact that JENSEN Units and JENSEN Rod Line Jacks get the job done so smoothly and efficiently. They incorporate more than 18 years of thoughtful experience and sound progress.

We cordially invite you to investigate and compare. See the JENSEN dealer in your territory, or wire us at Coffeyville.

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Quantitative Determination of Adulteration of Lubricating Oils by Means of Identifiers • • Part I

Results of private research work by the author in developing identifiers for detecting adulteration of lubricating oils

By
S. FISCHER, JR.

•

ALMOST difficult problem was placed before the writer by a firm producing Pennsylvania-base lubricating oils. For years, as stated by the heads of this firm, their laboratories, as well as dye houses, endeavored to find some means of identifying the amount of adulteration to which these particular Pennsylvania-base oils were subjected in the trade. This adulteration was, admittedly, from 20 to 30 percent. Their efforts were unsuccessful.

The matter resolved itself into a very complex problem. It was essential not only to determine quantitatively the adulteration of these high-priced Pennsylvania-base oils with cheaper grades, such as Mid-Continent stocks or naphthene-base stocks, but also the adulteration of such oils with other, cheaper grades of Pennsylvania-base oils.

It was imperative that such identification be permanent as to time, heat, light, and the ultra-violet rays of the sun. The test had to be a visual test in order to convince any jury of the quantitative adulteration of the stock under consideration. The test had to be iron-clad against addition of dyes or other color interferences. The ingredients added to the oil were not to change any of its vital properties. The cost should be below one-half cent per gal. of oil treated.

After due consideration of the problem from as many angles as possible, such as the visual determination of electrical and heat conductivity, index of refraction, effect of X-rays, effects of ultra-violet rays, etc., it was decided that the only effective means of identifying adulterated oils was by as foolproof a colorimetric test as possible.

The best evidence that can be offered for the completeness and the elegance of the work is that during the period of investigation, dating from July 14, 1931, to December 5, 1932, the date at which the final report was submitted to the company in question, neither their own laboratories nor the laboratories of a well-known dye house were able to break down or even identify one single item of the identifiers developed, namely, "Fischer's Identifiers." On the other hand, identifiers from the company's laboratory, as well as those submitted to the writer from the dye company mentioned, were readily torn down within a period of two days.

Though the introduction of the so-called "safety sealed cans" put an end to the value, at least temporarily, of these identifiers, the work of developing them is of interest to the oil industry.

Probably the best manner in which to present the results of this work is to take each individual substance used in the preparation of the identifiers and then combine them in the manner found most efficient for actual application in practice.

Phenolphthalein. As a result of work by the writer in connection with varnishes, phenolphthalein seemed most suitable, provided it could be dissolved in lubricating stocks.

The basic principle of operation was first, to find a solvent soluble in any lubricating oil, and capable of dissolving sufficient amounts of phenolphthalein to give a satisfactory test when admixed with the oil. It is imperative that the solvent-phenolphthalein mixture be of such a nature that only a minute quantity be required for a large volume of oil. If possible the volume of this mixture used with the oil should not be capable of being determined by quantitative methods of analysis; furthermore, it is essential that the amount of solvent-phenolphthalein mixture added be of such volume as in no manner, shape, or form to alter any one or any group of the vital properties of the oil so treated.

The ether, acetone, and ether-acetone solvents tried were found unsatisfactory. One striking phenomenon, however, may be mentioned in connection with these solvents for phenolphthalein. All apparently dissolved phenolphthalein, the best mixture being one composed of 50 percent acetone and 50 percent ether by volume; 0.2 gm. of phenolphthalein dissolved readily in ten cc. of this mixture. Solutions of small amounts of this combination seemed to dissolve readily in comparatively large volumes of oil. For example: one-half cc. of the solution of phenolphthalein in the acetone-ether mixture, added to 100 cc. of an oil and heated to 100 deg. centigrade gave perfectly clear oil solutions. When tested directly after cooling to normal temperatures no difficulty was encountered in obtaining quantitative results for the phenolphthalein content. When such oils, after treating for identification, were filtered and then tested, either very weak color reactions were obtained, or worse still, none at all.

Upon investigating this peculiar behavior, it was found that in some instances the phenolphthalein had filtered out completely. The phenolphthalein retained on the filter paper was not in the form of a powdery precipitate, rather in the form of a gel. Apparently, though, the oil contained the phenolphthalein and was entirely clear, even transmitted light compounds containing the phenolphthalein were formed, which, due to their gelatinous colloidal form were distributed throughout the oil uniformly, giving the appearance of complete transparency. Only after weeks of standing was a separation of these gelatinous compounds from the oil itself noticeable, the phenolphthalein compounds gradually settling to the bottom.

Many other solvents were tried with more or less success and finally the writer and his assistant investigated the

solvent properties of cyclohexanol commercially known as "Hexalin," "Anol," "Hydralin," or "Adronol."

This solvent showed remarkable properties. It proved to be the ideal solvent, not only for phenolphthalein, but also for other phthaleins and other organic compounds. This substance is an oily liquid almost water clear, having an approximate specific gravity at 60 deg. fahr. of 0.945, and a boiling-point range of 159 deg. to 162 deg. centigrade. It dissolves readily in lubricating oils and is neutral and non-phenolic in its action.

The final results of the work with hexalin were as follows: 7 lb. and 14 oz. of hexalin were weighed out and one lb. and four oz. of phenolphthalein were added. The mixture was heated to 212 deg. fahr. until a clear solution was obtained. Upon cooling to normal temperatures this solution remained clear and practically colorless. The stock solution thus obtained occupied 1.086 gal. while the 7 lb. and 14 oz. of hexalin is equal to exactly one gallon. Due to this increase in volume of the finished stock, the phenolphthalein content per gal. will be slightly less than one lb. and four oz. or 1.25 pound. The actual value of the phenolphthalein content per gal. of finished stock is 1.15 pound.

Treatment of a 2000-gal. Batch of Oil: Control is imperative in order to obtain absolutely uniform results. Introduce 2000 gal. of oil to be treated in a blender of the necessary capacity and heat the oil to 150 deg. fahrenheit. Agitate thoroughly and introduce from a suitable burette 224 cc. of the phenolphthalein stock solution. Agitate at the afore-mentioned temperature for approximately 30 minutes, cool and place in drums.

Upon further investigation it was observed that the heating to 150 deg. fahr. was not essential, provided the agitation is thorough. This is of value, especially should a company wish to begin using the identifier. In this instance, there will be larger or smaller tanks of oil in the field that must be treated in order to bring all the oil up to specifications for identification. This phenolphthalein stock solution can be introduced cold in such tanks in the field, provided suitable arrangements are made for thorough agitation.

Burettes are the best means of transferring the stock solution to an oil to be treated, for the reason that any number of cc. of stock solution may

TABLE I

RESULTS OBTAINED BY USE OF THE PHENOLPHTHALEIN-HEXALIN IDENTIFIER

1	2	3	4	5	6	7	8
Samples Made Up		Percent of Adulteration	Nessler Tube Readings in cm.		Determ. Percent R. T. O.	Determ. Percent Adulteration 100-Col. 6	Percent Error
cc. R. T. O.	cc. A. O.		R. T. O. Ext.	A. S. Ext.			
20	80	80	2.45	11.15	21.3	78.7	+1.3
75	25	25	2.00	2.70	74.1	24.9	+0.1
50	50	50	3.66	1.875	51.8	48.2	+1.8
100	0	0	9.10	9.25	101.6	1.6	—1.6

ABBREVIATIONS:
R. T. O.—Refinery Oil Treated with Phenolphthalein-Hexalin Identifiers.
A. O.—Oil Used for Adulteration.
A. S.—Adulterated Samples.
Ext.—Extract.

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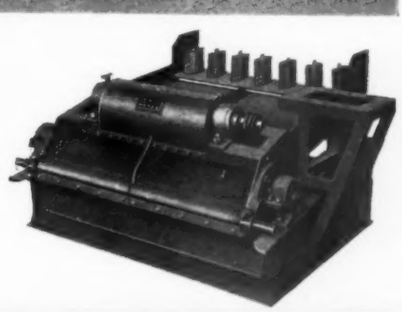

Ask your Supply House, see Page 1704 of the Composite Catalog, or write direct for detailed information.

The McNEELY Vibrating MUD SCREEN

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Gulf Coast and Mid-Continent Representative
BAROID SALES CO., HOUSTON, TULSA
EXPORT
The National Supply Corp. — Oil Well Supply Co.

be introduced into the oil without necessitating the washing out of the burette in order to obtain the last trace. Other containers would require a thorough cleaning with oil and one would never feel that all the identifier had entered the oil. With the small volume of identifier used, even a very minute loss would give incorrect results.

Preparation of Test Solution

Identification test: Dissolve 10 gm. of chemically pure sodium carbonate in 900 cc. of distilled water. When thoroughly dissolved make up to exactly 1000 cc. with more distilled water.

Obtaining the test color: 15 cc. of the treated oil is placed in a suitable separatory funnel. To this is added 15 cc. of ether. Shake well. Add 15 cc. of the above-described test solution and place the funnel in a shaking machine. Shake uniformly for ten minutes. Remove the funnel and allow to settle until two clearly defined layers are obtained. The upper layer will be the oil-ether mixture, and the lower layer the test solution layer containing the phenolphthalein. Its color is pink.

A quicker separation may be obtained by centrifuging the mixture contained in the separatory funnel. Centrifuges suitable for handling such separatory funnels are available from almost any house handling chemical equipment.

An example will not be out of place here. Assume a certain oil, treated at a plant with the phenolphthalein-hexalin indicator, be adulterated with 50 percent of a cheaper oil of the same base. Take two separatory funnels. Mark one "S" (standard) and the other "U" (unknown). Into the funnel marked "S" place 15 cc. of the plant-treated oil and into the funnel marked "U" 15 cc. of the adulterated oil. To each add 15 cc. of ether and shake. Then add to each 15 cc. of the test solution. Shake ten minutes. Place both funnels in centrifuge and centrifuge them under like conditions for ten minutes. Remove the funnels from the centrifuge. Draw off the lower layers separately and make them up to the same volume with more test solution. Compare these solutions in a colormeter.

The writer had no means of making these color comparisons other than with Nessler tubes, but the results turned out satisfactorily, as will be shown under the final identifiers. In all instances a dark orange background was used against which the colors were compared. The results were mostly within the accuracy demanded by the firm for whom the work was done.

The dilution ranges tested were from 100 percent treated oil to 3 percent treated oil, the remainder being oils foreign to the company's product. For very high dilutions with foreign oils, it is recommended to use more than 15 cc. of the adulterated oil, at times four or five times as much, depending upon the amount of adulterant used, mixing with the same volume of ether, but always only using 15 cc. of the test solution. By simple calculation the adulteration can then be figured back to the 15 cc. of the unadulterated standard sample used.

A basic rule to follow is this: treat the standard as you treat the adulterated sample. Not having had a centrifuge available, the writer was forced to allow the treated samples in his separatory funnels to settle. At times, the lower layers were not clear and had to be filtered. If the adulterated sample had to be filtered, the lower layer of the standard sample also was filtered. If more than one filtration was required for the unknown sample the same number of filtrations were used for the standard. Both filters were washed the same number of times and were made up to equal volumes. A given number of cc. of the standard

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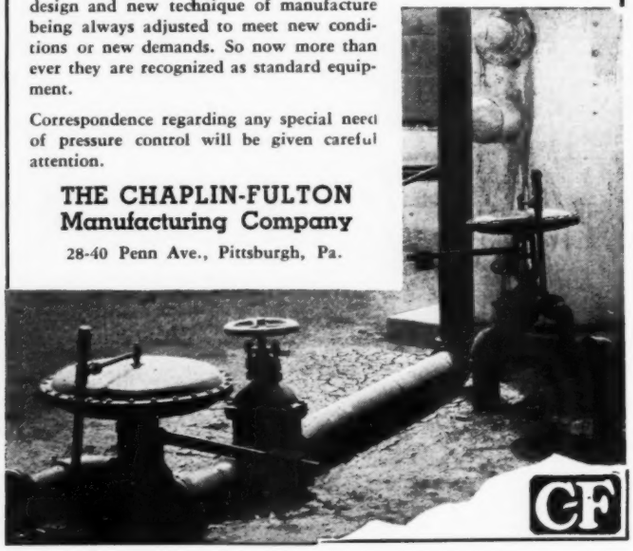

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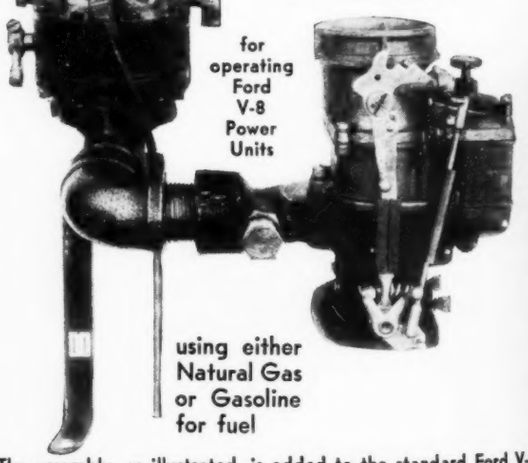

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90

color solution were then placed in a Nessler tube. In an identical Nessler tube so much of the colored solution of the unknown sample was added until the colors in both tubes matched. From these heights of liquids, the adulteration was calculated in the regular manner.

Basically, in testing for adulterated oils, what is actually determined is the volume of plant-treated stock in the adulterated sample, so that, if for example a sample tests 20 percent in color against a plant sample, which would be 100 percent, the adulteration would be 80 percent. Table 1 gives a series of results obtained in the manner described.

Considering the method of color comparison with Nessler tubes the percentage error in each instance is within the range of all practical work.

It is interesting to note the sensitivity of the phenolphthalein-hexalin indicator in this connection. According to calculations, 224 cc. of the phenolphthalein-hexalin indicator will contain 30.90 gm. of phenolphthalein. This volume is distributed among 2000 gal. of treated oil and, upon running a test, yields very decided color results; therefore, per gal. of treated oil, there would be but 0.01545 gm. of phenolphthalein present. As there are 3785.35 cc. per U. S. gal., the phenolphthalein contained per cubic centimeter is 0.000004 gm., or one part of phenolphthalein by weight, in 250,000 parts of oil by volume.

This particular sensitivity was recommended for use to the company for whom the work was done. It was mentioned, however, that one could use much less of the indicator per 2000 gal. than the amount suggested. For instance, one could use 56 cc. of the indicator for 2000 gal. and 60 cc. of oil for testing instead of 15 cc., bearing in mind to use an equal volume of ether, but maintaining 15 cc. of test solution. The sensitivity then, insofar as the color reaction is concerned, remains the same; but, instead of having 0.000004 gm. of phenolphthalein per cubic centimeter of oil, there would be only 0.000001 gm. of the effective indicator present per cc. of oil. The value of this decrease in indicator is self-evident, because of its great difficulty of detection by outsiders. The larger volume of ether used in this instance plays no role, as the ether in all instances, can be recovered to a great degree by simple distillation of the oil-ether mixtures. Adulterations up to 70 percent are readily detected by using 15 cc. of the oil under consideration for the test. For greater adulteration more oil would have to be used.

Though this indicator worked perfectly as described, many other conditions had to be satisfied. As previously mentioned, stability toward sunlight, interference with other colors, heat interference, effects on the properties of the oils, etc., had to be studied.

(*Editor's Note*—Part 2 of this article will appear in the February issue.)

Honor "Jack" Worthington

On the evening of December 19th about 40 employees of Petroleum Rectifying Company of California gathered at the Pacific Coast Club in Long Beach for a banquet in commemoration of J. T. Worthington's completion of 20 years of service with the company.

H. C. Eddy, chief engineer of the company, in whose honor a similar dinner was held three years ago, presided, and presented "Jack" with a gold wrist watch on behalf of Petreco employees.

A highlight of the evening was a radio broadcast fashioned after "The March of Time," which depicted highlights in Jack's career. One episode described the starting up of the first electrical dehydrating plant, which was installed under Jack's supervision in 1910 before he entered the employ of the company.

Worthington is now general field superintendent of Petreco's California Division with headquarters at Long Beach, California.

Allis-Chalmers Announces Subsidiary Change

Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin, announces that its subsidiary company, Condit Electrical Manufacturing Corporation, of Boston, Massachusetts, is being operated as a company unit since January 1, 1937. The plant is now known as Allis-Chalmers Manufacturing Company-Condit Works. The address is 1344 Hyde Park Avenue, Boston, Massachussetts.

The plant continues to specialize in the manufacture of switchgear products as a division of the electrical department under R. S. Fleshiem, manager. The personnel, with headquarters at Hyde Park, is as follows: George A. Burnham, assistant manager of the electrical department in charge of sales and engineering of the Switchgear Division; W. S. Edsall, manager of sales, Switchgear Division; H. V. Nye, engineer in charge of the Switchgear Division, with headquarters at Milwaukee.

The Works organization will be under the direction of Frank W. Young as manager, and Richard Bechtner, as assistant manager, reporting to Wm. Watson, vice-president at Milwaukee.

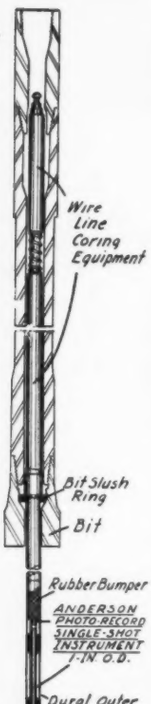
R. H. Closson will continue as production supervisor.

The accounting will be under the direction of Miss A. C. Newhall, reporting to J. A. Keogh, comptroller.

Employees Receive Bonus

All employees of The Bovaird Supply Company, Tulsa, Oklahoma, who have been in the service of the company a year or more, recently shared in a bonus amounting to one month's salary, with a half a month's salary to those employed from six months to a year, W. M. Bovaird, president, has announced.

This bonus was paid on December 21, and approximately 125 employees benefitted.



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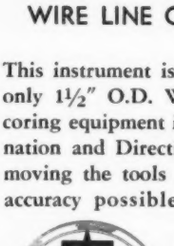
This instrument is run in a Dural Outer Case only 1½" O.D. When used with wire line coring equipment it provides readings of Inclination and Direction at any time without removing the tools from the hole. The greatest accuracy possible is secured by the Interchangeable Inclination Units that are furnished for maximums of 4°, 10° and 26°. A High Angle Unit for reading inclinations up to 55° is now available for directional drilling.



Above: A 4° Record.

Left: Showing use with wire line coring equipment.

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James F. Lincoln Arc Welding Foundation

Spurred by a dual desire to stimulate scientific development in the arc-welding field, and to honor the pioneer work of its president in promoting arc welding and perfecting and developing arc-welding equipment and electrodes, The Lincoln Electric Company, Cleveland, Ohio, has just completed its long-contemplated plans for establishing a Fund and Foundation to encourage study and research for benefit of the industry.

This new fund, voted by directors of the company at the turn of the year, has been named "The James F. Lincoln Arc Welding Foundation." Objects of the Foundation, and the significance of its name, are best set forth in the inaugurating resolution just adopted by The Lincoln Electric Company's board. This states in part:

JAMES L. LINCOLN

"Whereas, it is desired in the public interest that careful and extensive scientific study, research, and education in respect of development of the arc welding industry be encouraged; and,

"Whereas, the comparatively recent developments of electric arc welding disclose a vast field of study and research which yet is in its infancy . . . ; and

"Whereas, through such study and research, the public and modern industry should have the benefit of accurate knowledge and information in matters affecting the application of electric arc welding to machinery and equipment; and

"Whereas, it is the desire of this company to assist in furthering said objects and to provide suitable rewards therefor;

"Now, therefore, be it resolved that The Lincoln Electric Company should, and it does hereby, found, create and establish for such purpose, a scientific educational Fund and Foundation, which shall be organized and operated exclusively for the purposes as set forth in this resolution; and further, as a token of its esteem and respect for James F. Lincoln, and for his wide experience and interests in said scientific subjects, it denominates such as 'The James F. Lincoln Arc Welding Foundation'."

Principal direction of the Foundation's work will be given by Dr. E. E. Dreese, chairman of the Department of Electrical Engineering of The Ohio State University.

Other trustees who will serve with Dr. Dreese on the Foundation are W. B. Stewart, distinguished member of the Cleveland Bar, and H. R. Harris, vice-president of the Central United Bank of Cleveland.

Sperry-Sun Enlarges Service

Sperry-Sun Well Surveying Company has announced that since January 1st their engineer, S. W. Gurasich, is available for immediate service in the San Joaquin Valley of California. His address is: Elks Club, 17th and I Streets, Bakersfield, California. Phone: Bakersfield 2900.

"Oil Bank of America" Shows Big Gains

Deposits in the National Bank of Tulsa are up to $56,870,480.59, according to its statement of December 31, 1936. This is an increase of 22.04 percent over deposits of last year and 103 percent since December 31, 1933.

TRADE LITERATURE

"ORIENTED CORE BARREL" is the title of a recently-published 3-color, 8-page booklet, Bulletin 600, covering in story and pictures the new but proven Eastman method of determining formational dip and strike. The tool described does three important things, the manufacturers state: it recovers the core, it gives the angle off-vertical and the direction of deviation, and it establishes the direction in which the core was reposing at bottom of the hole. Copies of the bulletin are being sent upon request. Address Eastman Oil Well Survey Company, P. O. Box 1210, Dallas, Texas, or any Eastman branch office.

A NEW BULLETIN, describing in detail its entire line of products, has been issued by the Kibele Manufacturing Company, Dallas, Texas. The catalog includes complete description of Kibele tubing catchers, flow head packers, pump pistons, and swabs. Prices for each product also are printed in the catalog, which will be mailed free upon request.

DEEPWELL TURBINE PUMPS as built by the Byron Jackson Company, Los Angeles, California, are described and pictured in Bulletin 366 just issued by that company. Thirty-five years' experience provides the background for the complete line of Deepwell pumps now offered by the concern. A free copy of this very handsome brochure may be had by addressing the manufacturer.

Trade Personals

PAUL CAVINS, president of The Cavins Company, Long Beach, California, manufacturer of the Cavins automatic hydraulic suction bailer and fishing tool, made a business tour of the Mid-Continent recently. After swinging around the circuit of Cavins agencies in Texas, he returned to the coast in time to greet—or was it play—Santa on Christmas Eve.

A DAUGHTER was born to Mr. and Mrs. J. L. Mathieu on January 8th, this being their second daughter. Mathieu is advertising manager of the Schlumberger Well Surveying Corporation, Houston, Texas.

R. V. STOUT has joined the staff of the Lucey Products Corporation, and will direct the company's production equipment business in Kansas. He will have headquarters at Great Bend. Stout has had long experience in the production equipment division of the supply business, having lately represented the Jon R. Long Company of Fort Worth, Texas, and previously was associated with Mid-Continent Supply Company.

H. N. MCCLATCHEY, who has represented Byron-Jackson Company in the Seminole, Oklahoma, area, has resigned to join Lucey Products Corporation. McClatchey will continue to make his headquarters at Seminole.

HARVEY L. MILLER, assistant manager of tubular products sales for the Jones and Laughlin Steel Corporation, will have his headquarters at Dallas, Texas, it has been announced by officials of the corporation. Miller will give special attention to facilitating service on Jones and Laughlin oil country tubular products in the Mid-Continent, Southwest, and Gulf Coast areas.

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Dean Core Drills will bring smiles to the faces of the lads in your drilling crews. They'll be happy—and you'll be happier—because coring goes along without a hitch and perfect recoveries are made whatever the depth; in hard and soft formations alike. Write for our bulletin describing the Dean Core Drill design that has licked the toughest coring conditions time and again.

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Natural Gas Equipment Company Opens Houston Office

Announcement is made of the opening of a new office by Natural Gas Equipment Company of Texas, at 811 Sterling Building, Houston, Texas. Natural Gas Equipment Company has, for many years, been sales representatives for the Surface Combustion Corporation of Toledo and the Webster Engineering Company of Tulsa, as well as for the line of N. G. E.-Wilgus pressure regulators.

C. D. LANZIT

Natural Gas Equipment Company will direct its sales efforts at the boiler plants that supply power for drilling and refining operations.

In charge of the Houston office is C. D. Lanzit, N.G.E. field engineer long associated with Natural Gas Equipment, Inc., in their San Francisco and Los Angeles offices. Houston Oil Field Materials Company will act as distributors for N.G.E., assisting in the development of business.

Natural Gas Equipment products include N.G.E. Nelson Gas Burners for oil field boilers; N.G.E. Series 100 Gas Burners for boilers and furnaces; N.G.E. Boiler Feed Water Controllers; N.G.E.-Wilgus Boiler Gas Fuel Governors and Regulators; N.G.E.-Wilgus Damper Control Equipment; and N.G.E.-Wilgus Gas Head Regulators.

American Chain Company Changes Name

American Chain and Cable Company, Inc., is the new name of an old company, known previously as American Chain Company, Inc. The American Chain Company, long a large manufacturer of chains, has since 1924 become a leader also in the production of wire rope or cable for all purposes. It was this fact that prompted directors to enlarge the name to American Chain and Cable Company, Inc.

In addition to chain and wire rope, many other essential products are manufactured by the following divisions and associates of American Chain and Cable Company, Inc.: American Chain; Andrew C. Campbell; Manley Manufacturing; Page Steel and Wire; Wright Manufacturing; American Cable; Ford Chain Block; Hazard Wire Rope; Highland Iron and Steel; Own Silent Spring; Reading-Pratt and Cady, and Reading Steel Casting.

The directors recently elected W. B. Lashar chairman of the board; W. T. Morris, president; Wilmot F. Wheeler, executive vice-president and treasurer; A. P. Van Schaick, vice-president in charge of sales; C. G. Williams, vice-presi-

dent in charge of production; W. M. Wheeler, secretary; Frederick C. Geier, assistant secretary; and Stanley Mann, comptroller.

American Chain's familiar trade mark, known as the "ACCO Giant," will be retained.

The general executive offices will remain at Bridgeport, Connecticut, and 230 Park Avenue, New York City. District sales offices are at Boston, New York, Philadelphia, Detroit, Chicago, San Francisco, Pittsburgh, Atlanta, Tulsa, Houston, Denver, Los Angeles, and Fort Worth.

Manufacturing plants are at Bridgeport and Hartford, Connecticut; York, Reading, Monessen, Braddock, and Wilkes-Barre, Pennsylvania; Adrian, Michigan; and Terre Haute, Indiana. The Canadian affiliate, Dominion Chain Company, Ltd., is at Niagara Falls, Ontario. The British subsidiaries, The Parsons Chain Company, Ltd., and British Wire Products, Ltd., have offices in London, England.

Worthington Absorbs Associate Organization

Effective January 1st, the Worthington Company, Inc., with offices in Seattle, San Francisco, Los Angeles, and El Paso, was absorbed by its parent organization, Worthington Pump and Machinery Corporation, of Harrison, New Jersey.

This announcement follows that of December 28, covering the absorption by Worthington of its subsidiary, Carbondale Machine Corporation, builders of refrigeration, ice manufacturing, and air-conditioning equipment.

Worthington also announces the removal of its St. Louis district sales office to 3505 Lindell Boulevard; telephone, Jefferson 2177.

Two Prominent Families to Be Joined

S. A. GUIBERSON, JR.

Two families prominent in the oil industry will be joined this winter by the marriage of Miss Joan Skelly, daughter of Mr. and Mrs. W. G. Skelly, of Tulsa, Oklahoma, to S. A. Guiberson, III, son of Mr. and Mrs. S. A. Guiberson, Jr., of Dallas, Texas.

S. A. Guiberson, Jr., is president of the Guiberson Corporation, the Guiberson Diesel Engine Company, and the Guiberson Oil Company. He has been a director of the A.P.I. since its inception, and during the World War was director of pipe lines for the United States Government.

W. G. SKELLY

Skelly is head of the Skelly Oil Company with extensive holdings throughout the Mid-Continent area. He, too, has been a director of the A.P.I. since its beginning.

S. A. GUIBERSON, III

S. A. Guiberson, III, fiance of Miss Skelly, is vice-president and assistant manager of the Guiberson Corporation, vice-president of the Guiberson Diesel Engine Company, and president of the Algord Oil Company.

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